



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)



Department of Information Technology

Curriculum FE to BE for A.Y 2025-26

First Year to Final Year Syllabus

Prepared by: Board of Studies for Information Technology

**Approved By: Academic Council of Shree L.R. Tiwari College of
Engineering**

R 2025

PREAMBLE

"Think. Design. Innovate. – Learning that Leads the Future."

SLRTCE is proud to be among the youngest institutions to attain academic autonomy—an achievement that strengthens our commitment to becoming a world-class center for socio-economic development and quality education. It is with great pride and purpose that we introduce the restructured curriculum under academic autonomy at SLRTCE. This initiative marks a significant step toward transforming engineering education by equipping our graduates with strong technical foundations, research acumen, interdisciplinary perspective, and an innovation-driven mindset essential for success in today's evolving professional landscape.

1. Curriculum Design: Theme-Based, Experiential, and Outcome-Oriented The autonomous curriculum adopts a bottom-up, learner-centric approach aligned with all 12 Program Outcomes. Each semester is driven by a central societal or technological theme, with problem statements rooted in local needs, socio-economic priorities, and the UN Sustainable Development Goals (UNSDGs). Students engage with these challenges through individual projects in the IDEA Lab, integrating social science methodologies with engineering solutions to foster innovation, contextual learning, and socially responsible problem-solving.

2. Purpose of Autonomy: Empowering Innovation and Real-World Learning Our pursuit of autonomy is rooted in bridging the gap between academic learning and industry relevance. By integrating undergraduate research through the **IDEA Lab**—our dedicated innovation and problem-solving hub—students engage with real-world challenges, apply interdisciplinary knowledge, and develop socially impactful solutions. This approach nurtures engineers who are not only technically sound but also responsible and creative thinkers.

3. Alignment with National Education Policy-2020 Aligned with NEP 2020, the curriculum emphasizes multidisciplinary, hands-on learning. Through theme-based projects, electives, value-added courses, and flexible assessments, SLRTCE ensures holistic student development driven by real-world application and academic rigor. SLRTCE, as a part of Rahul Education, benefits from being in a network of HEIs. All Higher Education Institutions under Rahul Education can collectively contribute to curriculum development, promoting multidisciplinary studies.

4. Innovative Pedagogy Initiative by IQAC As part of its transformation strategy, IQAC has introduced an innovative pedagogy model centered on interdisciplinary research and contextual problem-solving. The IDEA Lab enables students to apply subject knowledge through socially relevant projects, supported by design thinking and faculty mentorship. A two-tier assessment framework—covering both project execution and subject-wise application—ensures academic depth, continuous mentoring, and quality assurance.

5. Empowering Faculty as Mentors and Innovators SLRTCE believes that the success of academic autonomy lies in the hands of its faculty. By empowering educators to think beyond conventional boundaries, we enable them to instill Knowledge, Skills, and Attitudes (KSA) in students while enriching their own professional growth. Faculty serve as research mentors and project guides, supported through structured training in innovation pedagogy and assessment.

Sincerely,

IQAC Chairperson

Chief Operating Officer

Shree L. R. Tiwari College of Engineering

Rahul Education

Preface

Dear Colleagues and Esteemed Members of the Board,

It is my pleasure to present the newly revised Information Technology curriculum—crafted under our recently granted Autonomous status and in compliance with NEP 2020 Building upon the strong foundational framework of SLRTCE’s legacy—where industry-oriented, tools-based learning complements core computing principles—this syllabus ushers in a truly student-centric, flexible, and future-ready programme.

Under NEP 2020’s emphasis on experiential, interdisciplinary, and outcome-based education, we have adopted a theme-based model where each semester focuses on real-world problem statements, drawn from local and global challenges mapped to relevant and the United Nations Sustainable Development Goals (UN SDGs) and supported by IDEA Lab for hands-on innovation and research — from design thinking to prototyping and product development. This approach not only fosters technical proficiency but also nurtures ethical leadership, social responsibility, and the entrepreneurial mindset required to become change-makers .

Moreover, in line with the National Credit Framework (NCRF) and the latest NBA accreditation guidelines, we have restructured the First and Second Year (Semesters I–IV) to ensure credit uniformity. Our curriculum’s flexibility allows us to swiftly incorporate emerging technologies and stakeholder feedback, minimizing the traditional four-year revision cycle.

I appreciate and thank our Mr Utsav Tiwari , COO Rahul Education and Principal, Dr.Deven Shah of Shree L R Tiwari College of Engineering for their valuable inputs. I extend my sincere gratitude to the contributors from academia, industry, and our Board for their invaluable insights—your guidance has been instrumental in shaping a programme that we trust will exceed the expectations of all our stakeholders.

I look forward to your constructive feedback and approval, as we collectively uphold SLRTCE’s vision of nurturing technically competent, ethically grounded, and socially conscious IT professionals prepared for the challenges of the 21st century.

Dr. Vikas Kaul

Chairperson, Board of Studies (IT), SLRTCE

Contents

Sr. No.	Item
1	Abbreviations
2	Curriculum Structure (F.E to B.E)
3	F.E Syllabus
4	S.E Syllabus
5	T.E Syllabus
6	B.E Syllabus

1. Abbreviations

Abbreviations	
AEC	Ability Enhancement Course
AECL	Ability Enhancement Course Laboratory
AU	Audit Course
BSC	Basic Science Course
BSCL	Basic Science Course Laboratory
CC	Co Curricular Courses
CEP	Community Engagement Project
ELC	Experiential Learning Course
ESC	Engineering Science Course
ESCL	Engineering Science Course Laboratory
HSSM	Humanities Social Sciences and Management
IKS	Indian Knowledge System
INTR	Internship
L	Lecture
LC	Laboratory Course
LLC	Liberal Learning Course
MDM	Multidisciplinary Minor
MDML	Multidisciplinary Minor Laboratory
MJP	Major Project
MP	Mini Project
OE	Open Elective
OJT	On Job Training
P	Practical
PCC	Program Core Course
PEC	Program Elective Course
SBL	Skill Based Laboratory
SEC	Skill Enhancement Course
SL	Self Learning
T	Tutorial
VEC	Value Education Course
VSEC	Vocational and Skill Enhancement Course

2. Curriculum Structure and Examination Scheme for B.E. in Information Technology

(FE with Effect from AY 2025-2026)

Curriculum Structure – FE Semester-I

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
15111101	BSC	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
15121102	ESC	Engineering Mechanics	2	--	--	30	--	--	30	60	2
15121103	ESC	Digital Logic & Computer Organization Architecture	3	--	--	45	--	--	45	90	3
15121104	ESC	Internet Technology	2	--	--	30	--	--	30	60	2
15121105	ESC	C and C++ Programming	3	--	--	45	--	--	45	90	3
15122106	ESCL	Engineering Mechanics Lab	--	--	1	--	--	15	--	15	0.5
15122107	ESCL	Digital Logic & Computer Organization Architecture lab	--	--	2	--	--	30	--	30	1
15122108	ESCL	Internet Technology lab	--	--	2	--	--	30	--	30	1
15122109	ESCL	C and C++ -Programming Lab	--	--	2	--	--	30	--	30	1
15122110	ESCL	IDEA LAB -1(Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2
15412111	VSEC	Workshop - I	--	--	2	--	--	30	15	45	1.5
98441112	Indian Knowledge System	Indian Knowledge System	2	--	--	30	--		30	60	2
98462113	CC	NSS & Civil Defense	—	--	4#	--	--	60	--	60	2
Total			15	1	15	225	15	225	255	720	24

Note:

1. IKS and CC will be common to all Branch
2. BSC , ESC and corresponding lab is Department Specific
3. Questions based on self learning must not be asked in internal assessment and End semester Exam
4. *IDEA Lab :The IDEA Lab fosters individual interdisciplinary projects through theme-based,

subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

5) # students need to complete 60 hours throughout the semester as it is not possible to get 4 hour/week due to dynamic schedule of government agencies

Notional Learning Hours:In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%.

The subject with no termwork and practical will have no assessment on self learning topics. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – FE Semester-I

Course Code	Course Type	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In- Semester Assessment			End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	TOTAL		End-Sem			
15111101	BSC	Linear Algebra and Calculus	20	20	40	60	2.5	25	–	125
15121102	ESC	Engineering Mechanics	20	20	40	60	2.5	–	–	100
15121103	ESC	Digital Logic & Computer Organization Architecture	20	20	40	60	2.5	–	–	100
15121104	ESC	Internet Technology	20	20	40	60	2.5	–	–	100
15121105	ESC	C and C++ Programming	20	20	40	60	2.5	–	–	100
15122106	ESCL	Engineering Mechanics Lab	–	–	–	–	–	25	-	25
15122107	ESCL	Digital Logic & Computer Organization Architecture lab	–	–	–	–	–	25	25	50
15122108	ESCL	Internet Technology lab	–	–	–	–	–	25	25	50
15122109	ESCL	C and C++ -Programming Lab	–	–	--	–	--	25	25	50
15122110	ESCL	IDEA LAB -1(Innovation Design Engineering and Apply)	–	–	--	–	--	50	50	100
15412111	VSEC	Workshop -I	–	–	--	--	--	25	--	25
98441112	IKS	Indian Knowledge System	20	20	40	60	2.5	–	–	100
98462113	CC	NSS & Civil Defense	–	–	–	–	–	25	–	25
Total			120	120	240	360	15	225	125	950

Curriculum Structure – FE Semester-II

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
15111201	BSC	Probability, Statistics, and Differential Equations	2	1	--	30	15	--	45	90	3
15111202	BSC	Modern Physics	2	--	--	30	--	--	30	60	2
15121203	ESC	Engineering Graphics	2	--	--	30	--	--	30	60	2
15211204	PCC	Data Structure	3	--	--	45	--	--	45	90	3
15112205	BSCL	Modern Physics lab	--	--	1	--	--	15	--	15	0.5
15122206	ESCL	Engineering Graphics Lab	--	--	2	--	--	30	--	30	1
15122207	ESCL	Modern Programming Paradigms lab	2	--	2	30	--	30	--	60	2
15122208	ESCL	IDEA LAB - 2 (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2
15212209	PCCL	Data Structure Lab	--	--	2	--	--	30	--	30	1
15412210	VSEC	Workshop - II	--	--	3	--	--	30	15	45	1.5
98461211	CC	Universal Human Values	2	--	--	30	--	--	30	60	2
98421212	AEC	Corporate Communication	1	--	--	15	--	--	15	30	1
98422213	AECL	Corporate Communication Lab	--	--	2	--	--	30	--	30	1
98471214	AU	Audit Course	3	--	--	45	--	--	--	45	--
	Total		18	1	13	270	15	195	225	705	22

Note:

1. CC and AEC will be common to all Branch
2. BSC , ESC and corresponding lab is Department Specific
3. Questions based on self learning must not be asked in internal assessment and End semester Exam
4. *IDEA Lab :The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

Notional Learning Hours:In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – FE Semester-II

Course Code	Course Type	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
				In- Semester Assessment		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
				IAT- 1	IAT- 2		End-Sem			
15111201	BSC	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	–	125
15111202	BSC	Modern Physics	20	20	40	60	2.5	–	–	100
15121203	ESC	Engineering Graphics	20	20	40	60	2.5	–	–	100
15211204	PCC	Data Structure	20	20	40	60	2.5	–	–	100
15112205	BSCL	Modern Physics lab	–	–	–	–	–	25	–	25
15122206	ESCL	Engineering Graphics Lab	–	–	–	–	–	25	25	50
15122207	ESCL	Modern Programming Paradigms Lab	–	–	–	–	–	25	25	50
15122208	ESCL	IDEA LAB - 2 (Innovation Design Engineering and Apply)	–	–	–	–	–	50	50	100
15212209	PCCL	Data Structure Lab	–	–	–	–	–	25	25	50
15412210	VSEC	Workshop - II	–	–	–	–	–	25	--	25
98461211	CC	Universal Human Values	–	–	–	–	–	25	--	25
98421212	AEC	Corporate Communication	20	20	40	40	1.5	--	--	80
98422213	AECL	Corporate Communication Lab	--	--	--	--	--	25	--	25
98471214	Audit Course	Audit Course	–	–	–	–	–	–	–	–
Total			100	100	200	280	11.5	250	125	855

Curriculum Structure – SE Semester-III

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
15211301	PCC	Discrete Mathematics and Graph Theory	2	1	–	30	15	–	45	90	3
15211302	PCC	Advance Data structure and Algorithm	3	-	--	45	--	--	45	90	3
15211303	PCC	Database Management Systems and Application	3	-	–	45	--	--	45	90	3
15211304	PCC	Automata Theory	3	–	–	45	--	--	45	90	3
15212305	PCCL	Advance Data Structure and Algorithm Lab	–	–	2	--	--	30	--	30	1
15212306	PCCL	SQL lab	–	–	2	--	--	30	--	30	1
9951137WW	OE	Open Elective	2	–	–	30	--	--	30	60	2
98431308	Entrepreneurship	Entrepreneurship Development	2	–	–	30	--	--	30	60	2
98451309	VEC	Environmental Science	2	–	–	30	--	--	30	60	2
15612310	CEP	IDEA LAB -3 (Innovation Design Engineering and Apply)	1	-	2*	15	--	30	15	60	2
Total			18	1	6	270	15	90	285	660	22

Note:

- 1) Entrepreneurship and Value education course will be common to all Branch
- 2) BSC , ESC, PCC and corresponding lab is Department Specific
- 3) Questions based on self learning must not be asked in internal assessment and End semester Exam
- 4) * IDEA Lab :The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."
- 5) Open Elective: To be selected from the bucket proposed by other institute of Rahul Education

Notional Learning Hours:In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SE Semester-III

Course Code	Course Type	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment\$			End Sem . Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	TOTAL		End-Sem			
15211301	PCC	Discrete Mathematics and Graph Theory	20	20	40	60	2.5	25	–	125
15211302	PCC	Advance Data structure and Algorithm	20	20	40	60	2.5	–	–	100
15211303	PCC	Database Management Systems and application	20	20	40	60	2.5	–	–	100
15211304	PCC	Automate Theory	20	20	40	60	2.5	–	–	100
15212305	PCCL	Advance Data Structure and Algorithm Lab	–	–	–	–	–	25	25	50
15212306	PCCL	SQL lab	–	–	–	–	–	25	25	50
9951137 WW	OE	Open Elective	–	–	–	–	–	25	–	25
98431308	Entrepreneurship	Entrepreneurship Development	–	–	–	–	–	25	–	25
98451309	VEC	Environmental Science	20	20	40	60	2.5	–	–	100
15612310	CEP	IDEA LAB -3 (Innovation Design Engineering and Apply)	–	–	–	–	–	50	50	100
Total			100	100	200	300	12.5	175	100	775

Curriculum Structure – SE Semester-IV

Course code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
15211401	PCC	Sampling theory and Optimization	2	1	--	30	15	--	45	90	3
15211402	PCC	Software Engineering and Project Management	3	--	--	45	--	--	45	90	3
15211403	PCC	Operating System	3	--	--	45	--	--	45	90	3
15212404	PCCL	SysOps Lab	--	--	2	--	--	30	--	30	1
15212405	PCCL	IDEA LAB -4(Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2
15412406	VSEC	Full Stack Development	--	--	2	--	--	30	--	30	1
9931147W	MDM	Multidisciplinary Minor Course	3	--	--	45	--	--	45	90	3
9931248W	MDML	Multidisciplinary Minor Course lab	--	--	2	--	--	30	--	30	1
9951149W	OE	Open Elective	2	--	--	30	--	--	30	60	2
98451410	VEC	Design Thinking	2	--	--	30	--	--	30	60	2
98431411	Entrepreneurship	Business Development Model	2	--	--	30	--	--	30	60	2
98471412	AU	Audit Course	3	--	--	45	--	--	--	45	--
Total			21	1	8	315	15	120	285	735	23

Note:

- 1) Entrepreneurship and VEC will be common to all Branch
- 2) BSC , ESC, PCC and corresponding lab is Department Specific
- 3) Questions based on self learning must not be asked in internal assessment and End semester Exam
- 4) * IDEA Lab :The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."

Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. This may involve lab work using the latest tools or preparing technical write-ups/research papers on advanced topics.

Examination Scheme – SE Semester-IV

Course Code	Course Type	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment			End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	TOTAL		End-Sem			
15211401	PCC	Sampling theory and Optimization	20	20	40	60	2.5	25	–	125
15211402	PCC	Software Engineering and Project Management	20	20	40	60	2.5	–	–	100
15211403	PCC	Operating System	20	20	40	60	2.5	–	–	100
15212404	PCCL	SysOps Lab	–	–	–	–	–	25	25	50
15212405	PCCL	IDEA LAB -4(Innovation Design Engineering and Apply)	–	–	–	–	–	50	50	100
15412406	VSEC	Full Stack Development	–	–	–	–	–	25	25	50
9931147 WW	MDM	Multidisciplinary Minor Course	20	20	40	60	2.5	–	–	100
9931248 WW	MDML	Multidisciplinary Minor Course lab	–	–	–	–	–	25	25	50
9951149 WW	OE	Open Elective	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business Development Model	–	--	–	–	--	25	–	25
Total			100	100	200	300	12.5	200	125	825

Curriculum Structure – TE Semester-V

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ITC501	Internet Programming	3	-	-	3	-	-	3
PCC	ITC502	Computer Network Security	3	-	-	3	-	-	3
PCC	ITC503	Entrepreneurship and E- business	3	-	-	3	-	-	3
PCC	ITC504	Software Engineering	3	-	-	3	-	-	3
PEC	ITC55X	Professional Elective Course-1	3	-	-	3	-	-	3
PCL	ITL506	IP Lab	-	2	-	-	1	-	1
PCL	ITL507	Security Lab	-	2	-	-	1	-	1
PCL	ITL508	DevOPs Lab	-	2	-	-	1	-	1
PCL	ITL509	Advance DevOPs Lab	-	2	-	-	1	-	1
	ITL510	Professional Communication & Ethics-II (PCE-II)	-	2*+2	-	-	2	-	2
PCL	ITL511	Mini Project – 2 A Web Based Business Model	-	4 ^{\$}	-	-	2	-	2
Total			15	16	-	15	08	-	23

* Theory class to be conducted for full class

\$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

ITC55X	Professional Elective Course – 1
ITC551	Microcontroller Embedded Programming
ITC552	Advance Data Management Technologies
ITC553	Computer Graphics & Multimedia System
ITC554	Advanced Data structure and Analysis

Examination Scheme – TE Semester-V

Course Type	Course Code	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment\$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	TOTAL		End-Sem			
PCC	ITC501	Internet Programming	20	20	40	60	2.5	-	—	100
PCC	ITC502	Computer Network Security	20	20	40	60	2.5	—	—	100
PCC	ITC503	Entrepreneurship and E-Business	20	20	40	60	2.5	—	—	100
PCC	ITC504	Software Engineering	20	20	40	60	2.5	—	—	100
PEC	ITC55X	Professional Elective Course – 1	20	20	40	60	2.5			100
PCL	ITL506	IP Lab	—	—	—	—	—	25	25	50
PCL	ITL507	Security Lab	—	—	—	—	—	25	25	50
PCL	ITL508	DevOPs Lab	—	—	—	—	—	25	25	50
PCL	ITL509	Advance DevOPs Lab	—	—	—	—	—	25	25	50
	ITL510	Professional Communication & Ethics-II (PCE-II)	—	—	—	—	—	25	25	50
PCL	ITL511	Mini Project – 2 A Web Based Business Model	—	—	—	—	—	25	25	50
Total			--	--	200	300	—	150	150	800

Curriculum Structure – TE Semester-VI

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ITC601	Data Mining & Business Intelligence	3	-	-	3		-	3
PCC	ITC602	Web X.0	3	-	-	3		-	3
PCC	ITC603	Wireless Technology	3	-	-	3		-	3
PCC	ITC604	AI and DS – 1	3	-	-	3		-	3
PEC	ITC65X	Professional Elective Course – 2	3	-	-	3		-	3
PCL	ITL606	BI Lab	-	2	-	-	1	-	1
PCL	ITL607	Web Lab	-	2	-	-	1	-	1
PCL	ITL608	Sensor Lab	-	2	-	-	1	-	1
PCL	ITL609	MAD & PWA Lab	-	2	-	-	1	-	1
PCL	ITL610	DS using Python Skill based Lab	-	2	-	-	1	-	1
PCL	ITL611	Mini Project – 2 B Based on ML	-	4 ^{\$}	-	-	2	-	2
Total			15	14	-	15	07	-	22

\$ indicates work load of Learner (Not Faculty), for Mini-Project. Students can form groups with minimum 2(Two) and not more than 4(Four). Faculty Load: 1hour per week per four groups.

ITC65X	Professional Elective Course – 2
ITC651	Software Architecture
ITC652	Image Processing
ITC653	Green IT
ITC654	Ethical Hacking and Forensic

Examination Scheme – TE Semester-VI

Course Type	Course Code	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment		TOTAL	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2			End-Sem			
PCC	ITC601	Data Mining & Business Intelligence	20	20	40	60	2.5	-	-	100
PCC	ITC602	Web X.0	20	20	40	60	2.5	-	-	100
PCC	ITC603	Wireless Technology	20	20	40	60	2.5	-	-	100
PCC	ITC604	AI and DS – 1	20	20	40	60	2.5	-	-	100
PEC	ITC65X	Professional Elective Course – 1	20	20	40	60	2.5	-	-	100
PCL	ITL606	BI Lab	–	–	–	–	–	25	25	50
PCL	ITL607	Web Lab	–	–	–	–	–	25	25	50
PCL	ITL608	Sensor Lab	–	–	–	–	–	25	25	50
PCL	ITL609	MAD & PWA Lab	–	–	–	–	–	25	25	50
PCL	ITL610	DS using Python Skill based Lab	–	–	–	–	–	25	25	50
PCL	ITL611	Mini Project – 2 B Based on ML	–	–	–	–	–	25	25	50
Total			--	--	200	300	--	150	150	800

Curriculum Structure – BE Semester-VII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ITC701	AI and DS –II	3	-	-	3	-	-	3
PCC	ITC702	Internet of Everything	3	-	-	3	-	-	3
PEC	ITC73X	Professional Elective Course- 3	3	-	-	3	-	-	3
PEC	ITC74X	Professional Elective Course- 4	3	-	-	3	-	-	3
OE	OEC75XX	Open Elective - 1	3	-	-	3	-	-	3
PCL	ITL706	Data Science Lab	-	2	-	-	1	-	1
PCL	ITL707	IOE Lab	-	2	-	-	1	-	1
PCL	ITL708	Secure Application Development	-	2	-	-	1	-	1
PCL	ITL709	Recent Open Source Project Lab	-	2	-	-	1	-	1
PCL	ITL710	Major Project I	-	4#	-	-	2	-	2
Total			15	12	-	15	6	-	21

indicates work load of Learner (Not Faculty), for Major Project

ITC73X	Professional Elective Course – 3
ITC731	Storage Area Network
ITC732	High Performance computing
ITC733	Infrastructure Security
ITC734	Software Testing and QA

ITC74X	Professional Elective Course – 4
ITC741	MANET
ITC742	AR – VR
ITC743	Quantum Computing
ITC744	Information Retrieval System

Open Elective Course (OE)

Every student is required to take one **Open Elective** Course for Semester VII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

OEC75XX	Open Elective - 1 (Common for all branches will be notified)
OEC7501	Product Lifecycle Management
OEC7502	Reliability Engineering
OEC7503	Management Information System
OEC7504	Design of Experiments
OEC7505	Operation Research
OEC7506	Cyber Security and Laws
OEC7507	Disaster Management and Mitigation Measures
OEC7508	Energy Audit and Management
OEC7509	Development Engineering

Examination Scheme – BE Semester-VII

Course Type	Course Code	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment\$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	TOTAL		End-Sem			
PCC	ITC701	AI and DS –II	20	20	40	60	2.5	-	–	100
PCC	ITC702	Internet of Everything	20	20	40	60	2.5	–	–	100
PEC	ITC73X	Professional Elective Course – 3	20	20	40	60	2.5	–	–	100
PEC	ITC74X	Professional Elective Course – 4	20	20	40	60	2.5	–	–	100
OE	OEC75XX	Open Elective - 1	20	20	40	60	2.5			100
PCL	ITL706	Data Science Lab	–	–	–	–	–	25	25	50
PCL	ITL707	IOE Lab	–	–	–	–	–	25	25	50
PCL	ITL708	Secure Application Development	–	–	–	–	–	25	25	50
PCL	ITL709	Recent Open Source Project Lab	–	–	–	–	–	25	25	50
PCL	ITL710	Major Project I	–	–	–	–	–	25	25	50
Total			--	--	200	300	–	125	125	750

Curriculum Structure – BE Semester-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ITC801	Blockchain and DLT	3	-	-	3		-	3
PEC	ITC82X	Professional Elective Course – 5	3	-	-	3		-	3
PEC	ITC83X	Professional Elective Course – 6	3	-	-	3		-	3
OE	OEC84XX	Open Elective -2	3	-	-	3		-	3
PCL	ITL805	Blockchain Lab	-	2	-	-	1	-	1
PCL	ITL806	Cloud computing Lab	-	2	-	-	1	-	1
PCL	ITL807	Major Project II	-	6#	-	-	3	-	3
OJT	OJT899	Internship/ Apprenticeship	-	8	-	-	4	-	4
Total			12	18	-	12	9	-	21

#indicates work load of Learner (Not Faculty), for Major Project

Students group and load of faculty per week.

Mini Project 1 and 2 :

Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load : 1 hour per week per four groups

Major Project 1 and 2 :

Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load :

In Semester VII – ½ hour per week per project group

In Semester VIII – 1 hour per week per project group

ITC82X	Professional Elective Course – 5
ITC821	Big Data Analytics
ITC822	Reinforcement learning
ITC823	Simulation and Modeling
ITC824	Knowledge management

ITC83X	Professional Elective Course – 6
ITC831	User Interface Design
ITC832	Robotics
ITC833	ERP
ITC834	Cloud computing and Services

Open Elective Course (OE)

Every student is required to take one **Open Elective** Course for Semester VIII, which is not closely allied to their disciplines. Different sets of courses will run in the both the semesters.

OEC84XX	Open Elective -2 (Common for all branches will be notified)
OEC8401	Project Management
OEC8402	Finance Management
OEC8403	Entrepreneurship Development and Management
OEC8404	Human Resource Management
OEC8405	Professional Ethics and CSR
OEC8406	Research Methodology
OEC8407	IPR and Patenting
OEC8408	Digital Business Management
OEC8409	Environmental Management

Examination Scheme – BE Semester-VIII

Course Type	Course Code	Course Name	Examination Scheme					Term Work	Practical & Oral	Total
			In-Semester Assessment		TOTAL	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2			End-Sem			
PCC	ITC801	Blockchain and DLT	20	20	40	60	2.5	-	-	100
PEC	ITC82X	Professional Elective Course – 5	20	20	40	60	2.5	-	-	100
PEC	ITC83X	Professional Elective Course – 6	20	20	40	60	2.5	-	-	100
OE	OEC84XX	Open Elective -2	20	20	40	60	2.5	-	-	100
PCL	ITL805	Blockchain Lab	-	-	-	-	-	25	25	50
PCL	ITL806	Cloud computing	-	-	-	-	-	25	25	50
PCL	ITL807	Major Project II	-	-	-	-	-	100	50	150
PCL	OJT899	Internship /Apprenticeship	-	-	-	-	-	25		25
Total			80	80	160	240	--	175	100	675

Indicative list of Multidisciplinary Minors:

Course Category of Multidisciplinary Minor	Course Code	MDM-I (Semester IV)	MDM-II (Semester V)	MDM-III (Semester VI)	MDM-IV (Semester VI)
Communication Engineering	993114701	Introduction to Telecommunication Systems	Mobile & Wireless Technology for Defence Communication	Telecommunication for Defense Sector	Multidisciplinary Project
	993124802	Introduction to Telecommunication Systems Lab	Mobile & Wireless Technology for Defense Communication Lab	Telecommunication for Defense Sector Lab	Multidisciplinary Project Lab
Internet of Technology	993114703	IOT Sensor Technology	IOT System Design	Dynamic Paradigm in IOT Project	Multidisciplinary Project
	993124804	IOT Sensor Technology Lab	IOT System Design Lab	Dynamic Paradigm in IOT Project Lab	Multidisciplinary Project Lab
Electronics Engineering	993114705	Basic Electronics Circuits	Analog & Digital IC	VLSI and Embedded systems	Multidisciplinary Project
	993124806	Basic Electronics Circuits Lab	Analog & Digital IC Lab	Analog VLSI Lab	Multidisciplinary Project
Mechanical Engineering	993114707	Smart Manufacturing in Assembly Line	Industrial Automation	Cyber Physical System	Multidisciplinary Project
	993124808	Smart Manufacturing Lab	Industrial Automation Lab	Cyber Physical System Lab	Multidisciplinary Project
Sustainability & Environment	993114709	Renewable and Non Renewable Energy System	Sustainable urban planning development	Geo Informatics	Multidisciplinary Project
	993124810	Renewable and Non Renewable Energy System Lab	Sustainable urban planning development Lab	Geo Informatics Lab	Multidisciplinary Project
Information Technology	993114711	Agentic AI	Data Engineering	Web Engineering	Multidisciplinary Project
	993124812	Intelligent Agents Lab	Data Engineering Lab	Web Engineering Lab	Multidisciplinary Project
Cyber Security	993114713	Information Security	Cyber Security	Open Source Intelligence	Multidisciplinary Project
	993124714	Information	Cyber Security	Open Source	Multidisciplinary

		Security Lab	Lab	Intelligence Lab	Project
Computer Engineering	993114715	Computational Thinking.	Applied Cryptography	Decentralized technology	Multidisciplinary Project
	993124716	Data Structure Lab	Data Security Lab	Blockchain Lab	Multidisciplinary Project
Artificial Intelligence	993114717	Foundations of Artificial Intelligence	Machine Learning for Engineers	Applied Deep Learning	Multidisciplinary Project
	993124818	Artificial Intelligence Lab	Machine Learning Lab	Deep Learning Lab	Multidisciplinary Project

MDM Sequels for EXTC:

- Internet of Technology
- Electronics Engineering
- Mechanical Engineering
- Sustainability & Environment
- Information Technology
- Cyber Security
- Computer Engineering
- Artificial Intelligence

MDM Sequels for ECS:

- Communication Engineering
- Internet of Technology
- Mechanical Engineering
- Sustainability & Environment
- Information Technology
- Cyber Security
- Computer Engineering
- Artificial Intelligence

MDM Sequels for Mechanical:

- Communication Engineering
- Internet of Technology
- Electronics Engineering
- Sustainability & Environment
- Information Technology
- Cyber Security
- Computer Engineering
- Artificial Intelligence

MDM Sequels for Civil:

- Communication Engineering
- Internet of Technology
- Electronics Engineering
- Mechanical Engineering
- Information Technology
- Cyber Security
- Computer Engineering
- Artificial Intelligence

MDM Sequels for IT:

- Communication Engineering
- Internet of Technology
- Electronics Engineering
- Mechanical Engineering
- Sustainability & Environment
- Cyber Security
- Computer Engineering
- Artificial Intelligence

MDM Sequels for CS:

- **Communication Engineering**
- **Internet of Technology**
- **Electronics Engineering**
- **Mechanical Engineering**
- **Sustainability & Environment**
- **Information Technology**
- **Cyber Security**
- **Artificial Intelligence**

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
9951137WW	Open Elective	2	-	-	2	-	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total .					
9951137WW	Open Elective	--	--	--	--	--	25	--	25

Students must select a course for Open Elective from a bucket provided by the Rahul Education Group.

Term Work Assessment: 25 Marks (Total marks) = 15 Marks (Case Study/Activity) + 5 Marks (Assignments) + 5 Marks (Attendance)

Internal Assessment and End Semester Exam Question Paper Structure

Internal Assessment for 20 Marks Each:

Internal Assessment (IA) will consist of two compulsory Internal Assessment Tests of 20 marks each. IAT-1 is to be conducted on three course outcomes of the syllabus and IAT-2 will be based on remaining three course outcomes. Duration of each test shall be one hour.

Summation of the two tests will be considered as IA marks.

End Semester Examination (60-Marks):

1. Question paper will comprise of total 06 questions, each carrying 10 marks
2. The questions for 10M will be based on each module of the syllabus.
3. All questions from Q No: 01 to Q No:06 will be compulsory and based on entire syllabus.
4. The option will be provided in the question itself like Q No:1 A OR Q no: 1 B Remaining questions will be in similar nature and selected from the respective module.
5. Total 06 questions need to be attempted.

F.E Syllabus

SEM 1

PREFACE

Theme : Digital Empowerment for All: Unlocking Opportunities through Accessible Technology in Mira Bhayandar and Beyond

Aligned with UNSDG 4: Quality Education, UNSDG 10: Reduced Inequalities, UNSDG 8: Decent Work and Economic Growth

Keywords: Accessible, digital literacy, disabilities.

This theme, " Digital Empowerment for All: Unlocking Opportunities through Accessible Technology in Mira Bhayandar and Beyond," is a critical framework for understanding how technology can be a powerful tool for positive social and economic change, particularly in a context like Mira Bhayandar. It directly addresses the aspirations of several United Nations Sustainable Development Goals (UNSDGs): Quality Education (4), Reduced Inequalities (10), and Decent Work and Economic Growth (8).

- **For Quality Education (UNSDG 4):**

- **Online Learning Access:** Providing students, especially those in underprivileged areas of Mira Bhayandar, with access to online educational resources, e-libraries, and virtual classrooms.
- **Digital Skills for Students:** Integrating digital literacy into school curricula, preparing students for a digitally-driven future.
- **Teacher Training:** Equipping educators with the skills to use technology effectively in their teaching and to adapt to diverse learning needs.
- **Special Needs Education:** Leveraging accessible technology to provide tailored learning experiences for children with disabilities, enabling their inclusion in mainstream education.

- **For Decent Work and Economic Growth (UNSDG 8):**

- **Digital Upskilling for Employment:** Training programs in coding, digital marketing, data analysis, and other in-demand digital skills for unemployed youth, women, and other vulnerable groups.
- **Gig Economy and Remote Work:** Enabling marginalized individuals to access online work opportunities and participate in the gig economy, providing flexible income sources.
- **Entrepreneurship and E-commerce:** Empowering small businesses and local artisans in Mira Bhayandar to leverage digital platforms for marketing, sales, and reaching wider markets.
- **Financial Inclusion:** Facilitating access to digital banking, mobile payments, and other financial services for those traditionally excluded from formal financial systems.
- **Accessible Workplaces:** Ensuring that digital tools and environments are accessible, allowing people with disabilities to secure and thrive in decent jobs.

- **For Reduced Inequalities (UNSDG 10):**

- **Equal Access to Information and Services:** Ensuring that all citizens, regardless of socio-economic status, location, gender, age, or disability, can access essential government services, healthcare information, and community resources online.
- **Voice and Participation:** Empowering marginalized groups to use digital platforms for advocacy, community organizing, and civic engagement, thereby increasing their voice in decision-making processes.
- **Bridging Gender and Rural-Urban Divides:** Targeted interventions to address specific digital disparities faced by women or by those in rural areas compared to urban centers like Mira Bhayandar.

- o **Empowerment of Persons with Disabilities:** By providing accessible technology, individuals with disabilities can overcome barriers to education, employment, and social participation, leading to greater independence and equality.

In the context of Mira Bhayandar, a rapidly developing urban area with diverse populations and varying levels of access and privilege, this theme is highly pertinent. It calls for strategic investments in infrastructure, digital literacy, and inclusive technology design to ensure that the city's growth is truly inclusive and benefits all its residents.

Problem Statement:

1. **"In Mira Bhayandar, many students from low-income families and individuals with learning disabilities often struggle to access quality educational resources and skill-building opportunities outside of traditional classroom settings due to a lack of affordable and accessible digital tools and relevant, engaging digital content. This gap limits their ability to independently learn, explore career paths, and develop essential digital literacy skills needed for decent work in the modern economy."**
2. **"Many small businesses, local artisans, and home-based entrepreneurs in Mira Bhayandar, particularly those run by women or individuals from marginalized communities, struggle to effectively leverage digital platforms for market access, sales, and business management due to a lack of digital literacy, affordable e-commerce tools, and understanding of online marketing. This digital exclusion limits their economic growth potential and ability to compete in a rapidly digitizing economy."**
3. **"Despite significant infrastructure development, many residents in Mira Bhayandar, particularly youth from lower-income backgrounds, lack the specific digital skills required for the new jobs emerging from the city's commercial and service sector growth (e.g., e-commerce logistics, digital customer support, smart city operations)."**
4. **"Accessing reliable, understandable, and culturally relevant health and wellness information remains a challenge for many vulnerable populations in Mira Bhayandar, including women, children, and the elderly, especially when considering digital literacy barriers and the complexity of medical jargon. This often leads to preventable health issues and unequal access to vital health knowledge that impacts their overall well-being and productivity."**
5. **"As the Mumbai Metro Line 9 expands into Mira Bhayandar, a significant portion of daily commuters, particularly those with low digital literacy or visual impairments, faces difficulties in accessing real-time, accurate, and accessible digital information regarding metro schedules, routes, delays, and last-mile connectivity."**
6. **"Individuals new to the digital world in Mira Bhayandar, often lack understanding of data privacy, online security practices, and how their personal information is used, leading to potential exploitation or reluctance to adopt digital services."**



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
15111101	Linear Algebra and Calculus	20	20	40	60	2.5	25	--	125

Rationale:

The study of matrices and systems of linear equations provides a fundamental toolkit for data representation and problem-solving in areas like computer graphics, image processing, and network analysis. Concepts such as eigenvalues and eigenvectors are essential in data science and machine learning applications, including dimensionality reduction techniques like Principal Component Analysis (PCA). Similarity and diagonalization simplify complex matrix operations, improving computational efficiency in simulations and algorithm design. Partial differentiation is vital for analyzing multivariable functions, particularly in optimization tasks used in AI model training and system tuning. Finally, the study of analytic functions in complex variables supports applications in signal processing and control systems, where complex analysis helps ensure system stability and performance. Together, these mathematical concepts form the analytical backbone for various practical and advanced topics in Information Technology Engineering.

R-2025- F.E Information Technology

Course Objectives:

1. To understand matrix operations and their application in data transformations and network models.
2. To learn methods to solve systems of linear equations relevant to coding theory and algorithm design.
3. To comprehend eigen concepts and their use in dimensionality reduction and pattern recognition.
4. To understand similarity transformations to optimize computations in IT algorithms.
5. To learn partial derivatives to optimize multi-variable functions in IT models.
6. To understand analytic functions and their application in signal processing and communications.

Course Outcomes:

1. Students will be able to apply matrix operations and use SCILAB to solve problems in data handling, graphics, and network modeling
2. Students will be able to analyze and solve linear systems and use SCILAB in algorithmic and cryptographic contexts
3. Students will be able evaluate eigenvalues and eigenvectors and use SCILAB for applications in machine learning and image processing
4. Students will be able to use diagonalization techniques and use SCILAB to simplify matrix computations and improve algorithm efficiency
5. Students will be able to apply partial differentiation and use SCILAB for optimization problems in machine learning and system design
6. Students will be able to analyze and apply concepts of analytic functions and use SCILAB in modeling communication signals and system behaviors.

Prerequisite:

1. Addition, multiplication, transpose, and inverse of a matrix.
2. Review of Complex Numbers-Algebra of Complex Numbers, Cartesian, polar and exponential form of complex number.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Matrices	Types of Matrices (Symmetric, Skew-symmetric, Hermitian, Skew-Hermitian, unitary, orthogonal matrices and properties of matrices).	05	CO1
		Rank of a matrix using Echelon form, reduction to normal form and PAQ form.		
		Application of matrices to Coding and De-coding		
		Self-learning Topics: 1. PAQ form for rectangular matrices. 2. Reduction to normal form. 3. Theorems on sum of symmetric and skew symmetric matrices and similar theorems. 4. Properties of transpose, conjugate of matrices	08	
II	System of Linear Equations	System of Linear homogeneous and non-homogeneous equations, their consistency and solutions using rank.	05	CO2
		Linear dependence and independence of vectors. Linear combination of vectors		
		Solution of a system of linear algebraic equations, by (i) Gauss Jacobi Iteration Method, (ii) Gauss Seidel Iteration Method.		
		Self-learning Topics: 1. Vector Spaces 2. Linear Transformations. 3. Rank -Nullity theorems.	08	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

III	Eigen values and Eigen vectors	Eigenvalues & eigenvectors of all types of matrices (symmetric, skew symmetric, orthogonal, triangular) and its properties (without proof).	05	CO3
		Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials		
		Self-learning Topics: 1. Quadratic forms. 2. Reduction to quadratic forms 3. Rank, signature and index of a quadratic forms	08	
IV	Similarity and diagonalization of matrix	Similar matrices, diagonalizable matrices, orthogonally diagonalizable matrices and functions of square matrix.	05	CO4
		Minimal polynomial, Derogatory and non-derogatory matrices.		
		Singular value decomposition (SVD)		
		Self-learning Topics: 1. Functions of Square Matrix 2. Orthogonally diagonalization.	07	
V	Partial Differentiation	Function of two and three variables, Partial derivatives of first and higher order. Differentiation of composite function.	05	CO5
		Maxima and Minima of a function of two independent variables.		
		Lagrange's Multiplier method with one condition.		
		Self-learning Topics: 1. Euler's Theorem on Homogeneous functions with two independent variables. 2. Euler's Theorem on Homogeneous functions with three independent variables.	07	



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
 Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
 DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		3. Deductions from Euler's Theorem. 4. Total differentials 5. Implicit Functions		
VI	Complex Variables – Differentiation	Circular functions of complex number and Hyperbolic functions. Analytic function, necessary and sufficient conditions for $f(z)$ to be analytic (without proof),		
		Cauchy-Riemann equations in Cartesian coordinates (without proof, Polar form not included)	05	CO6
		Milne-Thomson method to determine analytic function $f(z)$ when real (u) or imaginary part (v) is given.		
		Harmonic function, Harmonic conjugate, and orthogonal trajectories.		
		Self-learning Topics: 1. Expansion of $\sin^n \theta$, $\cos^n \theta$ in terms of sines and cosines of multiples of θ and Expansion of $\sin n\theta$, $\cos n\theta$ in powers of $\sin \theta$, $\cos \theta$. 2. Powers and Roots of a complex number. 3. Logarithm of Complex Number 4. Inverse Hyperbolic Functions. Separation of real and imaginary parts of all types of Functions.	07	

Text Books:

1. Grewal B. S.: "Higher Engineering Mathematics", Khanna Publishers, 44th Ed., 2021.
2. Kreyszig E.: "Advanced Engineering Mathematics", John Wiley & Sons, 10th Ed., 2018.
3. Dass H. K.: "Higher Engineering Mathematics", S Chand & Company Ltd, 12th Ed., 2004.
4. Narayan S.: "Differential Calculus", S.Chand Publications, 30th Ed., 2005.

R-2025- F.E Information Technology

References:

1. Strang G.: “Linear Algebra and its Applications”, Cengage Publications, 4th Ed. 2022.
2. Stewart J.: “Multivariable Calculus” Cengage Publications, 7th Ed., 2019.
3. Jain M.K., Iyengar SRK, Jain R K,: “Numerical Methods for Scientific and Engineering Computation”, New Age International Publishers, 6th Ed., 2007.
4. Bali N.P and Goyal M.: “A Textbook of Engineering Mathematics” Laxmi Publications, 10th Ed., 2022.
5. Williams G.: “Linear Algebra with Applications”, Jones Bartlett Publishers Inc., 6th Ed., 2017.
6. Wylie C. R, Barrett L.C.: “Advanced Engineering Mathematics” McGraw Hill Book Co., New York, 6th Ed., 2017.
7. Ramana B.V.: “Higher Engineering Mathematics”, Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
8. Gupta C.B, Sing S.R and Mukesh Kumar: “Engineering Mathematic for Semester I and II”, McGraw Hill Education, 2015.
9. Lay D. C: “Linear Algebra and its Applications”, Pearson Publishers, 4th Ed., 2018.
10. Pal S. & Bhunia S. C.: “Engineering Mathematics” Oxford University Press, 3rd Ed., 2016

Online References:

Sr. No.	Website Name
1.	https://www.math.ucdavis.edu/~daddel/linear_algebra_app/Applications/applications.html
2.	https://onlinelibrary.wiley.com/doi/10.1155/2016/4854759
3.	https://archive.nptel.ac.in/courses/111/108/111108066/
4.	https://archive.nptel.ac.in/courses/111/104/111104092/

R-2025- F.E Information Technology

Term work(TW) for 25 marks:

1. Batch-wise tutorials are to be conducted.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write **at least 4 SCILAB tutorials** (including print out) and **at least 8** class tutorials on entire syllabus.
3. SCILAB Tutorials on entire syllabus

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks
2. Class Tutorials on entire syllabus 10 marks
3. SCILAB Tutorials 10 marks



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	S L	Notional Learning Hour	
15121102	Engineering Mechanics	2	-	-	30	-	-	-	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15121102	Engineering Mechanics	20	20	40	60	2.5	--	--	100

Rationale:

Engineering mechanics is a branch of science that deals with the behaviour of solid bodies when subjected to external forces or loads and the effects of these forces on the bodies. Though traditionally software-focused, Computer and IT engineers increasingly interact with physical systems through areas like robotics, virtual reality, gaming, digital twin technology, and simulation. Engineering Mechanics introduces the physical principles of force, motion, and equilibrium, which are essential for the development of realistic simulation engines, AI-based mechanical system models, and integration of software with hardware systems. This subject helps build computational models of mechanical phenomena and enhances interdisciplinary competence for modern applications.

Course Objectives

- 1 To acquaint with basic principles of Centroid and its real-life significance
- 2 To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.
- 3 To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.
- 4 To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.
- 5 To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

6 To acquaint with the basics of Robot kinematics

Course Outcomes

- 1 Demonstrate the understanding of Centroid and locate the same.
- 2 Determine the resultant and equivalent force-couple system for a given system of forces.
- 3 Illustrate the concept of loads, supports, beams, conditions of equilibrium, and friction and apply the same in two dimensional systems with the help of FBD.
- 4 Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear and general plane motion.
- 5 Apply the principles of force and acceleration, work-energy and impulse-momentum to particles in motion.
- 6 Establish the relation between robot joints and parameters

Prerequisite: Student shall have passed HSC (Higher Secondary Certificate) along with basic understanding of physics and mathematics in following topics:-

1. **Basic Vector Algebra**
 - Understanding of vector addition, subtraction, scalar and vector products.
 - Ability to resolve vectors into components.
2. **Fundamentals of Classical Physics**
 - Concepts of force, motion, Newton's laws, equilibrium, and gravity.
 - Understanding of mass, weight, friction, and types of motion.
3. **Basic Trigonometry and Geometry**
 - Familiarity with sine, cosine, tangent functions.
 - Knowledge of angles, triangles, and coordinate systems.
4. **Problem-Solving and Logical Reasoning Skills**
 - Ability to approach real-world physical problems logically.
 - Basic analytical thinking and spatial reasoning

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
0	Prerequisite	Statics, Dynamics, Kinetics, Kinematics, Rigid body, Deformable body, applying trigonometric functions, resolution of a vector (Force vector), Law of triangle, Polygon law of forces, Newton's laws of motion Velocity, acceleration, displacement, Uniform velocity and accelerated motion, Law of conservation of Energy, Law of conservation of Momentum, work-energy principle, impulse and	01 01	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		momentum principle, and Coefficient of restitution		
1	Centroid	i. Characteristics, and real-life significance for Centroid ii. Centroids of primary geometrical shapes and plane laminas Self-learning topic: - Centroid for area with sector and real-life application - Exploring Moment of Inertia for primary geometrical shapes and plane laminas	03 03	CO1
2	Force and System of Forces	i. Principle of transmissibility, Moment of force about a point and concept of couple ii. Classification of force systems iii. Resultant of coplanar system of forces and Varignon's Theorem iv. Resultant of non-coplanar concurrent system of forces Self-learning topic: - Exploring force and a couple system and real-life application of a force and a couple system - Resultant of non-coplanar parallel and general system of forces	05 05	CO2
3	Equilibrium and Friction	i. Conditions of equilibrium for system of forces and free body diagrams, Types of beams, loads, and support and its reaction ii. Equilibrium of beams, rollers, and system of bodies iii. Laws of friction. Cone of friction. angle of repose, and angle of friction iv. Application of equilibrium with friction on blocks on horizontal and inclined planes and ladders Self-learning topic:	07	CO3



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		- Equilibrium of connected bodies (beam and sphere), two force and three force members, beams connected using internal hinges - Application of equilibrium with friction - Wedge and block	07	
4	Kinematics of particles and rigid bodies	i. Motion along plane curved path, Variable acceleration for rectilinear motion, projectile motion ii. Introduction to General plane motion, problem based on Instantaneous centre (ICR) method for general plane motion (up to 2 linkage mechanism and roller) Self-learning topic: - Application of motion graph for real-life problems - ICR for rollers, wheels and three links problems - ICR for system of rigid bodies	06 06	CO4
5	Kinetics of particles	i. Introduction to D'Alembert's Principle (DAP), inertia force, dynamic equilibrium, Work done by active forces, impact and collision ii. Problems on DAP (single and double block), and WEP (single block) Self-learning topic: - Application of WEP to the real-life problems - Explore the concept of impact and collision for rigid bodies	04 04	CO5
6	Introduction to Robot Kinematics	i. Fundamental of Robot Mechanics, Degree of Freedom, D-H Parameters, robot kinematics (Forward) ii. Homogeneous transformation (limited to 2 DOF Serial robot) Self-learning topic:	04	CO6



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		- Derive and Analyze - Manual derivation of forward kinematics using D-H parameters - Explore online simulation tools such as MATLAB Robotics Toolbox Online and refer https://kinematicsplayground.org/ - Solve 2 numerical problems involving: Assigning D-H parameters and finding of end-effector pose using transformation matrices	04	

Text Books:

1. Engineering Mechanics by A K Tayal, Umesh Publication.
2. Engineering Mechanics by Kumar, Tata McGraw Hill
3. Engineering Mechanics by Beer & Johnston, Tata McGraw Hill

References:

1. Engineering Mechanics by R. C. Hibbeler.
2. Engineering Mechanics by F. L. Singer, Harper & Row Publication
3. Engineering Mechanics by Macklin & Nelson, Tata McGraw Hill

Online References:

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/106/112106286/
2	https://archive.nptel.ac.in/courses/112/106/112106180/



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15121103	Digital Logic & Computer Organization Architecture	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
15121103	Digital Logic & Computer Organization Architecture	20	20	40	60	2.5	--	--	100

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Rationale :

This course lays the foundation for digital electronics and computer architecture, essential for all engineering branches, especially Computer, Electronics, and IT. It covers number systems, logic circuits, memory, and system architecture, enabling students to design and analyze basic digital systems. Through practical case studies and real-life applications, students develop skills to build inclusive and intelligent digital solutions for societal needs.

Course Objectives:

1. To impart knowledge of number systems, binary codes, logic gates, and Boolean function minimization.
2. To enable design and analysis of combinational and sequential digital circuits.
3. To develop understanding of computer organization, control unit design, and pipelining.
4. To explain hierarchical memory organization and cache memory implementation.
5. To implement arithmetic algorithms and data representation standards.
6. To analyze I/O architectures and data transfer mechanisms in computing systems

Course Outcomes: At the end of the course students will be able to

1. Apply number system conversions, binary codes, and K-map minimization for digital logic circuits.(L1,L2,L3)
2. Design and evaluate combinational and sequential circuits including counters and shift registers.(L1,L2,L3,L4)
3. Demonstrate understanding of computer architecture, control unit design, and instruction execution. (L1,L2,L3)
4. Analyze memory hierarchy, cache mapping techniques, and coherency mechanisms. (L1,L2,L3,L4)
5. Perform arithmetic operations using Booth's algorithm, signed division, and IEEE 754 standards. (L1,L2,L3,L4)
6. Compare and implement I/O systems using programmed I/O, interrupts, and DMA techniques. (L1,L2,L3)

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Prerequisite: Boolean Algebra basics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Boolean Algebra basics		
I	Computer Fundamentals	Introduction to Number System and Codes. Number Systems: Binary, Octal, Decimal, Hexadecimal. and their conversions, 1's and 2's complement Codes: Grey, BCD, Excess-3, ASCII, Boolean Algebra. reduction using Boolean laws. Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR. Standard. SOP and POS form. Reduction of Boolean functions using K-map method (2,3,4 Variable), Don't care condition, NAND, NOR Realization Logic.	8	CO1
		Self-learning Topics: Number System, Quine-McCuskey, codes conversion.	5	
II	Design of Combinational and Sequential Logic	Combinational Circuits: Half & Full Adder, Half & Full subtractor, introduction to Multiplexers and Demultiplexers, Encoders & Decoders. Sequential Circuits: Introduction to Flip Flops: SR, JK, D, T, master slave flip flop, Truth Table. Counters: Introduction to Asynchronous and Synchronous Counters, UP- DOWN counter. Shift Registers: SISO, SIPO, PIPO, PISO.	8	CO2
		Self-learning Topics: McCluskey, Flip-Flop conversion, Counter Design, Universal Shift Register, Ring and twisted ring/Johnson Counter.	7	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

III	Introduction of Computer Organization and Architecture	Introduction of Computer Organization and Architecture. Basic organization of computer and block level description of the functional units. Evolution of Computers, Von Neumann model. Performance measure of Computer Architecture, Amdahl's Law. Instruction interpretation and sequencing. Control Unit: Soft wired (Microprogrammed) and hardwired control unit design methods. Introduction to parallel processing concepts, Flynn's classifications, instruction pipelining, pipeline hazards.	8	CO3
		Self-learning Topics: CISC VS RISC Architecture, Microinstruction sequencing and execution. Micro operations, concepts of nano programming. Case study : Design a Power-Efficient Architecture Model for Solar-Based Digital Learning Kits	8	
IV	Memory Organization	Introduction to Memory and Memory parameters. Classifications of primary and secondary memories. Types of RAM and ROM, Allocation policies, Memory hierarchy and characteristics. Cache memory: Concept, locality of reference, architecture (L1, L2, L3), mapping techniques. Cache coherence and write policies., Interleaved and Associative memory.	6	CO4
		Self-learning Topics: Case study on Memory Organization, Numerical on finding EAT, Address mapping, Virtual Memory Management-Concept, Segmentation, Paging, Page Replacement policies.	8	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

V	Data Representation and Arithmetic Algorithm	Booth's algorithm. Division of integers: Restoring and non-restoring division, signed division, basics of floating-point representation IEEE 754 floating point(Single & double precision) number representation.	7	CO5
		Self-learning Topics: Real-World Applications of Booth's Algorithm in Digital Signal Processing (DSP) and Embedded Systems, Comparative Study of Booth's Algorithm vs. Traditional Binary Multiplication	9	
VI	I/O Organization	Input/output systems, I/O module-need & functions and Types of data transfer techniques: Programmed I/O, Interrupt driven I/O and DMA Case study : 1. Develop a Number System Conversion App (Binary/Decimal/Hex/Octal) with audio output for visually impaired learners. 2. Designing a Digital Clock Interface for Visually Impaired Users Using BCD and ASCII Codes. 3. Low-Cost Digital Learning Kit for Children with Learning Disabilities 4. Smart Voting Booth Logic Using Priority Encoders and Decoders for Inclusive Civic Participation. 5. Queue Management System for Clinics Using Counters and Flip-Flops Implementation of Floating Point-Based Health Metrics Calculator for ASHA Workers	8	CO6
		Self-learning Topics: Comparison of all I/O methods and their uses.	8	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- F.E Information Technology

Text Books:

1. R. P. Jain, "Modern Digital Electronics", TMH
2. M. Morris Mano, "Digital Logic and Computer Design", PHI
3. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, Fifth Edition, Tata McGraw-Hill.
4. William Stallings, Computer Organization and Architecture: Designing for Performance, Eighth Edition, Pearson.

References:

1. Anand Kumar, "Fundamentals of Digital Circuits", PHI
2. Donald P Leach, Albert Paul Malvino, "Digital Principals & Applications", TMH.
3. B. Govindarajulu, Computer Architecture and Organization: Design Principles and Applications,
4. Computer Architecture and Organization: Design Principles and Applications, Tata McGraw-Hill
5. Dr. M. Usha, T. S. Srikanth, Computer System Architecture and Organization, First Edition, Wiley-India.
6. John P. Hayes, Computer Architecture and Organization, Third Edition., McGraw-Hill Publication.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.geeksforgeeks.org
3.	https://www.coursera.org/



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15121104	Internet Technology	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15121104	Internet Technology	20	20	40	60	2.5	--	--	100

Rationale :

In today's digitally driven world, the Internet has become the foundation for communication, commerce, education, and innovation. Understanding Internet Technology is essential for students to harness the power of web-based platforms, applications, and services that impact all industries and aspects of daily life. This course provides students with the technical knowledge and practical skills required to design, develop, and deploy interactive and accessible web solutions. Through this subject, learners will gain insight into the core principles of web architecture, standards, and tools, equipping them to build user-centric, responsive, and semantically correct

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

websites. Students will also explore modern trends such as responsive design, multimedia integration, data formats (XML/JSON), and UI/UX prototyping using tools like Figma. The course emphasizes both technical proficiency and design thinking, ensuring students can develop solutions that are not only functional but also accessible, inclusive, and visually appealing.

Course Objectives:

- 1 To introduce students to the fundamentals of the Internet, web technologies, and protocols.
- 2 To enable students to build well-structured, semantic, and accessible web pages using HTML5.
- 3 To apply CSS3 for creating responsive, visually appealing, and device-independent web layouts.
- 4 To introduce structured data representation using XML and JSON, enabling them to understand syntax, validation methods, and practical applications in data exchange.
- 5 To introduce students to Figma for UI/UX design and prototyping in web and mobile development.
- 6 To apply theoretical concepts to real-world case studies focusing on digital empowerment and civic engagement.

Outcomes: Students will be able to

1. Understand the evolution, structure, and working principles of the Internet and core web technologies including DNS, protocols, and document models. (L1,L2,L3)
2. Design and develop web pages using semantic HTML5 elements with proper structure, accessibility features, and multimedia integration. (L1,L2,L3,L4,L5,L6)
3. Use CSS3 to create responsive, interactive, and animated web pages with layout control, transitions, and visual styling techniques. (L1,L2,L3,L4,L5,L6)
4. create, validate, and compare XML and JSON documents for effective use in web and application-based data communication. (L1,L2,L3,L4)
5. Use Figma to prototype web and mobile user interfaces, demonstrate navigation flow, component reuse, and collaborative design sharing. (L1,L2,L3,L4,L5)
6. Apply web development concepts to real-life case studies such as health portals,



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

educational platforms, and library systems to promote digital empowerment
(L1,L2,L3,L4,L5,L6)

Prerequisite: None

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	Introduction to Internet technology	1.1 Introduction to Web & Internet, History and Evolution of Internet, Internet vs Extranet vs Intranet 1.2 Working of web browser, HTTP/HTTPS protocols DNS, TLS/SSL (security implications) DOM (Document Object Model), URL, URI, Introduction	03	CO1
		Self-learning Topics: Explore Nginx and Apache web servers.	03	
II	HTML AND HTML5	2.1 Introduction to HTML. Purpose and Structure. Evolution of HTML to HTML5. 2.2 Basic Tags, Text Formatting. Headings and Paragraphs. 2.3 Lists, Hyperlinks and Anchors, Images: Tag and attributes, Grouping Elements, Tables, Input type: 2.4. HTML5 Form Validations: required, pattern, placeholder, autofocus. 2.5 Semantic Elements, Benefits of semantic HTML Accessibility and SEO advantages Multimedia and Embedding in HTML5	06	CO2

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

			Self-learning Topics: Introduction to <canvas> and SVG for basic graphics. New Input Types: email, URL, search, color, range	07	
III	CSS AND CSS3		3.1 Introduction to CSS. Purpose and advantages of CSS, Types of CSS: 3.2 CSS Syntax and Selectors: Text properties, Backgrounds, Borders and Outlines, Margin and Padding, Width, Height, and Box Model. 3.3 Display property, Positioning Advanced Selectors (attribute selectors, pseudo-classes) 3.4 CSS3 – Gradients, Rounded Corners Shadows, Transitions and Animations, Transform: rotate, scale, translate opacity and visibility	06	CO3
			Self-learning Topics: Z-index, Overflow handling, CSS Grid (basic introduction)	06	
IV	XML AND JSON		4.1 Basics of XML: Tags, Elements, Attributes XML Syntax Rules, Well-formed vs Valid XML, XML Document Structure: Prolog, DTD, CDATA 4.2 Namespaces in XML, Document Type Definition (DTD), XML Schema Definition (XSD) 4.3 Introduction to JSON and its advantages, Syntax and Data Types, JSON Objects, Arrays, Nested JSON JSON vs XML: Comparison of use-cases and performance	06	CO4
			Self Learning Topics : XML Editors and Validation Tools (e.g., Oxygen XML, XML Notepad), Explore Public APIs that return JSON (e.g., Open Weather, GitHub, News APIs)	05	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

V	UI/UX - Figma	5.1 What is Figma? Interface and Navigation 5.2 Creating Frames, Shapes, and Text 5.3 Designing Web Pages and Mobile Screens 5.4 Components and Reusability 5.5 Prototyping and Interactive Links Exporting and Sharing Designs	05	CO5
		Self Learning Topics: Figma Plugins and Community Resources	05	
VI	Application on Interent Technology	CASE STUDY 1 : Instagram-like animations use transitions and transform properties. Case Study : 2 Netflix and Amazon use responsive design to adapt layout for mobile and desktop. Case Study 3: Develop a simple education content portal for youth and adult learners in Mira Bhayandar. Case Study 4: Build an online web interface for local public libraries where users can:Search available books, Reserve a book, View due dates and return policies Case Study 5: Smart Health Info Portal - Design a mobile-friendly health information portal for Mira Bhayandar residents that displays nearby clinics, emergency contacts, and health tips. Case Study 6: Feedback System for Digital Services- Develop a simple citizen feedback system for digital services in Mira Bhayandar Case Study 7: UI Prototype for Local Government App - Create a Figma-based prototype for a digital public service app aimed at simplifying service like birth certificate	05	CO6
		Self Learning : Mobile-First Web Development Techniques, Postman - API testing tool to work with JSON, XML, and RESTful service.	05	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- F.E Information Technology

Text Books:

1. **H. M. Deitel, P. J. Deitel, A. B. Goldberg**, Internet & World Wide Web – How to Program, 5th Edition, Pearson Education.
2. **Sasha Vodnik**, HTML5 and CSS3, Illustrated Complete, Cengage Learning, Latest Edition.
3. **Kogent Learning Solutions Inc.**, Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET, XML and Ajax, Black Book, Dreamtech Press, Latest Edition.
4. **Jon Duckett**, Web Design with HTML, CSS, JavaScript and jQuery Set, Wiley, 1st Edition.
5. **Masud Hossain**, Figma for UI/UX Design, Independently Published, 2022

References:

1. Andrew S. Tanenbaum, *Computer Networks*, 4th Edition, Pearson Education.
2. ISRD Group, *Internet Technology and Web Design*, McGraw Hill Education, Latest Edition.
3. Randy Connolly, Ricardo Hoar, *Fundamentals of Web Development*, Pearson Education, Latest Edition.
4. Jennifer Niederst Robbins, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, 4th Edition, O'Reilly Media.
5. James F. Kurose, Keith W. Ross, *Computer Networking: A Top-Down Approach*, 7th Edition, Pearson Education.

Online References:

Sr. No.	Website Name
1.	Figma official tutorials
2.	Mozilla Developer Network (MDN) – HTML/CSS/JS docs
3.	W3Schools Tutorials
4.	CSS Tricks
5.	FreeCodeCamp



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15121105	C and C++ Programming	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical / Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration in Hrs.			
		IAT-1	IAT-2	Total					
15121105	C and C++ Programming	20	20	40	60	2.5	--	--	100

Rationale:

The C and C++ Programming course serves as a foundational pillar for first-year engineering students across all branches by developing essential problem-solving and programming skills. It introduces students to both structured and object-oriented programming paradigms, fostering logical thinking and algorithmic design. As C is widely used in system-level programming and C++ forms the basis for modern software development, this course ensures students gain proficiency in writing efficient, modular, and scalable code. Its relevance spans all engineering

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- F.E Information Technology

disciplines, supporting applications in simulation, automation, modeling, and control systems. By laying the groundwork for advanced subjects like data structures, algorithms, and embedded systems, the course prepares students for future academic and professional challenges in an increasingly digital and automated world.

Course Objectives:

- 1 **To introduce** the fundamentals of programming using C and C++, focusing on syntax, semantics, and program structure for developing simple, efficient solutions.
- 2 **To develop** the ability to apply control structures, functions, arrays, and strings in solving computational and real-world engineering problems.
- 3 **To enable** students to understand and implement user-defined data types such as structures, unions, and enumerations for effective data management.
- 4 **To build** foundational knowledge of pointers, memory management, and file handling to facilitate low-level programming and system-level applications.
- 5 **To provide** a conceptual and practical understanding of object-oriented programming features in C++, including classes, objects, inheritance, polymorphism, and abstraction.
- 6 **To prepare** students for advanced computing courses by enhancing their analytical thinking, debugging skills, and ability to write modular, maintainable, and reusable code.

Course Outcomes:

Upon successful completion of the course, the learner will be able to:

1. **Understand and apply** the basic concepts of C programming, including algorithm development, structured programming, data types, operators, control structures, and input/output operations, to develop simple programs.
2. **Apply and analyze** the concepts of functions, arrays, and strings in C to solve computational problems using modular and structured programming techniques.
3. **Apply and analyze** the use of pointers, structures, and file handling techniques to manage memory efficiently and perform structured data operations in C programming.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

4. **Understand and apply** the fundamental concepts of object-oriented programming in C++, including classes, objects, encapsulation, constructors, and member functions to design modular programs.
5. **Analyze and apply** advanced object-oriented programming concepts such as polymorphism, inheritance, virtual functions, and abstraction in C++ to develop flexible and reusable software components.
6. **Understand and evaluate** best programming practices, debugging techniques, and industry standards like MISRA guidelines, and **relate** C/C++ programming to real-world applications and emerging technologies.

Prerequisite: Nil.

Detailed Syllabus:

M. No.	Module Name	Detail Topics	Hours	CO Mapping
0	Prerequisite	• Basic familiarity with fundamental mathematical and logical reasoning skills. • Understanding of basic computer operations – such as using a keyboard, mouse, operating systems, and file handling. • Logical thinking and problem-solving ability – including flowcharting, algorithmic thinking, and basic decision-making. • Basic English comprehension skills – to read and write code, understand syntax, and follow programming logic.	--	--
1	Fundamentals of C Programming	• Introduction to Programming, algorithms and Flowcharts • Program Development Life Cycle (PDLC) - Structure of a C Program, Compilation, Execution • Concepts of Structured Programming in C	8	CO1

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		• Data Types, Program Statements, Token, Identifiers, Keywords, Constants, Assignment, Declaration and Initialization, Variables, Operators and Expressions, Lvalue and Rvalues, • Input/Output Functions, Type Conversion and Typecasting • Control Structures: if, else, switch-case, loops (for, while, do-while), break, continue, goto		
		Self-Learning Topics: • Write-up on history and evolution of programming languages • Practicing Non-Formatted Input & Output functions – getchar(), putchar(), getch(), getche(), putch(), gets(), puts() • Practicing Formatted Input & Output functions – printf() - % Format specifiers, formatting the output, escape sequences, Runtime adjustment and precision – Input Function scanf() – format specifiers, formatted input. • Preprocessor Directives in C • Implement pattern generation programs and logic puzzles • Research: Role of C in Embedded Systems • Practicing program development logic using Combines Multiple Control Statements: Number guessing game, ATM simulation program, Login system with 3 attempts limit, Magic number finder, Menu-driven bank management functions	8	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

2	Functions, Arrays, and Strings	• Functions: Prototype Declaration, Definition, Function Calling, Passing Parameters to the Function, Scope of Variables, Call by Value. • Storage Classes: auto, static, register, extern • Recursive Functions, Recursion Vs Iteration • Arrays: 1D, 2D Arrays – Declaration, Initialization, Accessing Array Elements, Operations on Arrays, Applications • Strings: Declaration, Initialization, String Operations, Array of Strings, String manipulation Functions in string.h	8	
		Self-Learning Topics: • Sorting an array, Binary searching • Declaration and Initialization of a Multidimensional Array • Matrix addition, multiplication • Arrays of strings: Two-dimensional character array • Passing Arrays to Functions • Character manipulation in the String using character functions in <ctype.h> • Implement recursive solutions (e.g., Fibonacci, Tower of Hanoi) • Comparison of recursion and iteration (mini presentation) • Industry application: Use of arrays/strings in data processing	8	CO2
3	Pointers, and Structures	• Pointers: Basics, address operator (&), Declaring & initializing Pointer Variables, Indirection Operator and Dereferencing, Pointer Expressions and Pointer Arithmetic, Types of Pointers, Pointer	7	CO3

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		to Pointers, Pointers and Arrays, Call. by value vs Call by address. • Dynamic Memory Allocation (malloc, calloc, realloc, free) • Structures and Unions, Declaring Structures and Structure Variables, Accessing the members of a structure, Initialization of Structures, typedef, Nested Structures, Arrays of Structures,		
		Self-Learning Topics: • Call by address using pointers, returning more than one value from a function, returning pointer from a function, structures and pointers, passing structure to function • Structure versus Union, Enumeration types • Processing binary files • Write mini programs for file encryption/decryption • Technical write-up: Memory leaks and how to avoid them • Tools: Memory debugging using Valgrind (demonstration/presentation)	7	
4	Introduction to Object-Oriented Programming (C++)	• Differences between Procedural and Object-Oriented Programming • Introduction to C++, Structure of a C++ Program • Classes and Objects, Standard input and output stream objects, Access Specifiers, Data hiding and Encapsulation, Array of Objects • Constructors and Destructors • Friend Functions, Inline Functions	7	CO4
		Self-Learning Topics: • Explore syntax differences between C and C++	7	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		- Implement class-based programs (Employee Management System, Account Management banking system, Addition of Complex Numbers, student management) - Defining the member functions outside the class - Research: Applications of OOP in industry tools (e.g., game development, simulations)		
5	Advanced OOP Concepts (C++)	Inheritance: Creating a Parent-Child relationship between Classes, Types of Inheritance, Implementing Multilevel and Hybrid Inheritance Polymorphism: Introduction of Polymorphism, Types of Polymorphism, Compile time Polymorphism: Function overloading, operator overloading, Rules for operator overloading, Run time polymorphism: Virtual functions, rules for virtual functions, pure virtual function.	8	CO5
		Self-Learning Topics: - Working of Constructors with Multiple Inheritance Creating a “String” data type – An example using Operator and function overloading - Create inheritance-based applications (e.g., employee hierarchy system) - Mini project proposal based on OOP concepts - Read and summarize advanced topics like Templates or Exception Handling	8	
6	Industry Applications and Programming Practices	- Best Practices in Programming: Modularization, Comments, Code Reusability - Debugging Techniques, Error Handling - Applications in Embedded & Real-Time Systems - Introduction to Competitive Programming – Objectives, how it works, Benefits, platforms	7	CO6

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		- Overview of Software Development Life Cycle (SDLC) - MISRA C and MISRA C++ Safe Coding Rules - Role of C/C++ in current technologies (AI, IoT, Game Development, System Software)		
		Self-Learning Topics: - Research paper or technical write-up on advanced use of C/C++ (e.g., real-time systems, kernel dev) - Online platform practice (e.g., HackerRank, Codeforces, CodeChef, etc.) - Seminar/presentation on any emerging tech using C/C++	7	

Text Books

- "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.
- "Object Oriented Programming with C++" by E. Balagurusamy, McGraw Hill Education.
- "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
- "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
- "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
- "Let Us C", by Yashavant Kanetkar, BPB Publications.

Reference Books

- "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall.
- "Programming: Principles and Practice Using C++" by Bjarne Stroustrup, Addison-Wesley
- "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
- "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
- "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	S L	Notional Learning Hour	
15122106	Engineering Mechanics Lab	-	-	1	-	-	15	-	15	0.5

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IA T 1	IA T 2	Total					
15122106	Engineering Mechanics Lab	--	--	--	--	--	25	--	25

Rationale:

Engineering mechanics is a branch of science that deals with the behaviour of solid bodies when subjected to external forces or loads and the effects of these forces on the bodies. Though traditionally software-focused, Computer and IT engineers increasingly interact with physical systems through areas like robotics, virtual reality, gaming, digital twin technology, and simulation. Engineering Mechanics introduces the physical principles of force, motion, and equilibrium, which are essential for the development of realistic simulation engines, AI-based mechanical system models, and integration of software with hardware systems. This subject helps build computational models of mechanical phenomena and enhances interdisciplinary competence for modern applications.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Lab Objectives:

1. To acquaint with basic principles of Centroid and its real-life significance
2. To familiarize with the concepts of force, moment, couple, resultant and system of coplanar and non-coplanar forces.
3. To familiarize with the concepts loads, beams, equilibrium conditions, friction and their real-life applications.
4. To understand the motion parameters required for quantification of Kinematics of Particle and Rigid body.
5. To understand the combination of force and motion parameters required for quantification of Kinetics of rigid body.
6. To acquaint with the basics of Robot kinematics

Lab Outcomes:

1. Demonstrate the understanding of Centroid locate the same.
2. Determine the resultant and equivalent force-couple system for a given system of forces.
3. Illustrate the concept of loads, supports, beams, conditions of equilibrium, and friction and apply the same in two dimensional systems with the help of FBD.
4. Determine the position, velocity, and acceleration of particle and rigid body using principles of kinematics for rectilinear, curvilinear, and general plane motion.
5. Apply the principles of force and acceleration, work-energy and impulse- momentum to particles in motion.
6. Establish the relation between robot joints and parameters

List of Experiments:

Minimum six experiments from the following list of which a minimum one should be from dynamics.

Sr. No.	List of Experiments	Hrs	CO mapping
1	Verification of Polygon law of coplanar forces (Universal force table apparatus)	01	CO2
2	Verification of the Principle of Moments (Bell crank lever)	01	CO2
3	Determination of Centroid of plane lamina made up of standard geometrical shapes	01	CO1
4	Determination of support reactions of a Simply Supported Beam.	01	CO3
5	Determination of coefficient of friction using inclined plane	01	CO3



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

6	Verification of the equations of equilibrium for non-concurrent non-parallel (General) force system.	01	CO3
7	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	01	CO4
8	Collision of elastic bodies (Law of conservation of momentum).	01	CO5
9	Kinetics of particles. (collision of bodies)	01	CO5

Sr No	List of Assignments / Tutorials	Hrs	CO mapping
01	Centroid of composite plane laminae (3 Numerical)	01	CO1
02	Resultant of coplanar and non-coplanar system of forces (2 Numerical)	01	CO2
03	Equilibrium of beam, rollers, bodies on inclined plane with friction and ladders with friction (6 Numerical).	03	CO3
04	Kinematics of particles and rigid bodies (7 Numerical)	03	CO4
05	Kinetics of particles (3 Numerical)	01	CO5
06	Homogeneous transformation, and Direct Kinematics of robot (5 Numerical)	02	CO6
07	Resultant of Co-planar system of forces for concurrent system of forces using C programming language.	02	CO1
08	Equilibrium of beam for support reactions using C programming language	02	CO3

Assessment:

Term Work: Term Work shall consist of at least 06 practicals based on the above list. Also, Term work Journal must include all the assignments listed above.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122107	Digital Logic & Computer Organization Architecture Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122107	Digital Logic & Computer Organization Architecture Lab	--	--	--	--	25	25	50



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Lab Objectives:

1. Understand the basic structure and internal components of a **computer system**, including PC motherboard architecture (South Bridge and North Bridge).
2. Develop practical knowledge of **number system conversions**.
3. Design and implement **logic circuits**, including basic and universal gates, using hardware or simulation tools.
4. Build and verify basic **combinational circuits**, including adders, subtractors, multiplexers, and demultiplexers.
5. Explore and implement **sequential circuits**, such as flip-flops, counter and shift registers, for data storage and manipulation applications.
6. Provide exposure to **arithmetic algorithms** such as Booth's algorithm for binary multiplication.

Lab Outcomes: Students will be able

1. **Identify and describe the architecture and internal components** of a computer system, including the role of the South Bridge and North Bridge. (L1,L2)
2. **Convert decimal numbers to binary, octal, and hexadecimal formats** using programming lab, demonstrating understanding of number systems. (L3)
3. **Design, implement, and test logic circuits**, including basic gates (AND, OR, NOT, EX-OR) and universal gates (NAND, NOR) using hardware or simulation tools.(L3,L4)
4. **Construct and verify combinational circuits**, such as adders, subtractors, multiplexers, and demultiplexers for basic arithmetic and selection operations. (L3,L4)
5. **Implement and analyze sequential circuits**, including SR, JK, D, T flip-flops, counter and shift registers for data storage and transfer applications. (L3,L4)
6. **Implement Booth's Algorithm for binary multiplication** using software simulation to perform efficient arithmetic operations. (L3,L4)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

List of Experiments.

NOTE: Programs can be executed on simulator or hardware boards.

Sr No	List of Experiments	Hrs
01	Study of PC Motherboard Technology (South Bridge and North Bridge), Internal Components and Connections used in computer system.	2
02	Write a program to convert Decimal to Binary, Octal, and Hexadecimal using C programming	2
03	Realization of Logic Gates (AND, OR, NOT, NAND, NOR, EX-OR) using basic electronic components or simulation tools (Multisim/Proteus/Logisim).	2
04	Implementation of SOP and POS expressions using Logic Gates.	2
05	Realize basic gates using universal gates using NAND	2
06	Realize basic gates using universal gates using NOR	2
07	Design and Implementation of Half-Adder and Full-Adder circuits using Logic Gates.	2
08	Design and Implementation of Half-Subtractor and Full-Subtractor circuits.	2
09	Study and Implementation of Multiplexer and Demultiplexer circuits.	2
10	Study and Implementation of Encoder and Decoder circuits.	2
11	Flip-Flop Simulation: SR, JK, D, T with Truth Tables	2
12	To implement synchronous up down counter	2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

13	Design and Verify the 4-Bit Serial In - Parallel Out Shift Registers.	2
14	Implement Booth's Algorithm for Binary Multiplication (Software simulation).	2
15	Case study : Role of foundational computing concepts in building inclusive educational technology.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment Covers the topics first three modules of Digital Logic & Computer Architecture: Computer Fundamentals, Design of Combinational and Sequential Logic, Introduction of Computer Organization and Architecture	2
02	Assignment Covers the topics next three modules of Digital Logic & Computer Architecture: Memory Organization, Data Representation and Arithmetic Algorithm, I/O Organization	2

Text Books:

1. Thomas L. Floyd, Digital Fundamentals, Pearson Education, Latest Edition.
2. M. Morris Mano, Computer System Architecture, Pearson Education, 3rd Edition.
3. Charles H. Roth, Fundamentals of Logic Design, Cengage Learning, Latest Edition.

References:

1. R.P. Jain, Modern Digital Electronics, McGraw Hill, Latest Edition.
2. M. Morris Mano, Digital Logic and Computer Design, Pearson Education.
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, McGraw Hill.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Online Resources:

Sr. No.	Website Name
1	http://www.cburch.com/logisim/
2	https://www.labcenter.com/
3.	https://www.vlab.co.in/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122108	Internet Technology Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122108	Internet Technology Lab	--	--	--	--	25	25	50

Rationale :

In today's digitally driven world, the Internet has become the foundation for communication, commerce, education, and innovation. Understanding Internet Technology is essential for students to harness the power of web-based platforms, applications, and services that impact all industries and aspects of daily life. This course provides students with the technical knowledge and practical skills required to design, develop, and deploy interactive and accessible web solutions. Through this subject, learners will gain insight into the core principles of web architecture, standards, and tools, equipping them to build user-centric, responsive, and semantically correct websites. Students will also explore modern trends such as responsive design, multimedia integration, data formats (XML/JSON), and UI/UX prototyping using tools like Figma. The course emphasizes both technical proficiency and design thinking, ensuring students can develop solutions that are not only functional but also accessible, inclusive, and visually appealing.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

📞 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Lab Objectives:

- 1 Understand and explore how web technologies (HTML, CSS, XML, JSON, UI tools) function in practical scenarios.
- 2 To design structured web pages using HTML elements, multimedia, and semantic tags.
- 3 To create interactive and validated web forms using HTML5 input types and attributes.
- 4 To apply CSS for styling, layout control, and implement animations and transformations using CSS3.
- 5 To work with XML and JSON data formats for data storage and transmission.
- 6 To explore the fundamentals of UI/UX design through Figma and create interactive web and mobile app prototypes.

Lab Outcomes: Students will be able to

- 1) analyze and apply various web technologies to build basic interactive web components using appropriate tools and standards. (L1,L2,L3,L4)
- 2) create accessible and semantically rich HTML web pages incorporating text, links, images, audio, and video elements.(L3, L4,L5,L6)
- 3) develop user-friendly web forms with appropriate input types and implement client-side validations using HTML5 features. .(L3, L4,L5,L6)
- 4) design visually appealing layouts using CSS3, including responsive design, transitions, and transformations. .(L3, L4,L5,L6)
- 5) create, parse, and validate structured XML and JSON data, and understand their use in web communication. (L2,L3,L6)
- 6) design and prototype user interfaces using Figma, applying core UI/UX principles for both web and mobile platforms. (L3, L4,L5,L6)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Experiment 1: Title: Explore Working of Web Browsers and HTTP/HTTPS Aim: Understand and demonstrate basic HTTP request and response cycles using browser dev tools. Tools: Chrome/Firefox DevTools	2
02	Experiment 2: Title: Domain Name System (DNS) and Secure Protocols	2

*R-2025- F.E Information Technology*

	Aim: Use nslookup, dig, and test SSL/TLS via browser or openssl to explore DNS and HTTPS behavior.	
03	Experiment 3: Title: Create a Personal Web Page using HTML Aim: Use basic tags, headings, paragraphs, links, and images to build a static web page.	2
04	Experiment 4: Title: Develop Forms with HTML5 Validations Aim: Create a form with input types (text, email, URL, number), use required, pattern, placeholder, etc.	2
05	Experiment 5: Title: HTML Image Gallery Aim: Create a photo gallery using and grouping elements like <figure> and <figcaption>.	2
06	Experiment 6: Title: Embedding Multimedia in HTML5 Aim: Use <audio>, <video>, <iframe> to embed media files in a web page.	2
07	Experiment 7: Title: Apply CSS Styles to a Web Page Aim: Implement inline, internal, and external CSS. Style headings, paragraphs, and lists.	2
08	Experiment 8: Title: CSS Layout using Box Model, Margin, and Padding Aim: Demonstrate how margin, padding, borders, and box-sizing affect layout.	2
09	Experiment 9: Title: CSS3 Transitions and Transformations Aim: Create animations using transition, transform, and hover effects (scale, rotate, translate).	2
10	Experiment 10: Title: Design and Validate an XML Document Aim: Create a well-formed XML document with DTD or XSD for a book catalog or student list.	2
11	Experiment 11: Title: Work with JSON Data Aim: Create and parse JSON object using JavaScript. Compare with equivalent XML.	2
12	Experiment 12: Title : Explore Figma Interface	2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

	Aim: Understand the Figma workspace, tools, and navigation.	
13	Experiment 13: Title: Create Simple Shapes and Layout Aim: Practice using shape tools and alignment such as Draw rectangles, circles, and lines. Group shapes to form basic layout (e.g., card or banner). Use alignment and distribution tools	2
14	Experiment 14: Title: Create a Mobile App UI in Figma Aim: Use Figma to design wireframes, components, and a prototype of a mobile app interface.	2
15	Experiment 15 : Mini Project	2

Sr No	List of Assignments / Tutorials	Hrs
01	BASIC OF INTERNET TECHNOLOGY	2
02	HTML AND HTML5	2
03	CSS AND CSS 3	2
04	XML AND JSON	2
05	FIGMA	2
06	CASE STUDY ON INTEGRATION OF HTML CSS XML AND JSON	2

Text Books:

1. **Uttam Kumar Roy**, *Web Technologies: HTML, JavaScript, PHP, Java, JSP, ASP.NET*, Oxford University Press, Latest Edition.
2. **Jennifer Niederst Robbins**, *Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics*, 5th Edition, O'Reilly Media.
3. **H. M. Deitel, P. J. Deitel, A. B. Goldberg**, *Internet & World Wide Web – How to Program*, 5th Edition, Pearson Education.
4. **K. Meena, R. Sivakumar**, *Web Technology: A Developer's Perspective*, Revised Edition, PHI Learning.
(Includes XML, DTD, Schema, and JSON basics in web development context.)

R-2025- F.E Information Technology

References:

1. **Elisabeth Freeman, Eric Freeman**, *Head First HTML and CSS*, 2nd Edition, O'Reilly Media.
2. **Matthew MacDonald**, *HTML5: The Missing Manual*, Latest Edition, O'Reilly Media.
3. **Elliott Rusty Harold**, *XML in a Nutshell*, 3rd Edition, O'Reilly Media.
4. **Eric A. Meyer**, *CSS: The Definitive Guide*, 4th Edition, O'Reilly Media.
5. **Figma Team**, *Figma Learn Tutorials and Docs*, Latest Edition, <https://help.figma.com>.

Online Resources:

Sr. No.	Website Name
1.	FreeCodeCamp – Free hands-on courses with certification.
2.	W3Schools – Comprehensive tutorials with live editors for HTML, CSS, JS.
3.	JSON.org – Official page with structure and use-cases.
4.	XML Validation Tool – Online tool for validating XML and DTD/XSD.
5.	Figma Learn Hub – Official tutorials and documentation.

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122109	C and C++ Programming Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122109	C and C++ Programming Lab	--	--	--	--	25	25	50

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



R-2025- F.E. Information Technology

Lab Objectives:

1. To introduce students to the fundamental programming constructs of C and provide hands-on experience with writing, compiling, debugging, and executing simple programs using an IDE.
2. To enable students to develop modular and efficient C programs by exploring functions, recursion, and arrays, enhancing their understanding of data management.
3. To familiarize students with advanced C programming concepts such as structures, pointers, dynamic memory allocation, for effective data storage and manipulation.
4. To provide comprehensive exposure to object-oriented programming in C++ focusing on classes, objects, constructors, destructors.
5. To deepen understanding of advanced object-oriented concepts in C++ including inheritance, polymorphism, virtual functions, and abstract classes for designing flexible software solutions.
6. To guide students in designing and implementing an object-oriented system in C++ that integrates key programming concepts for practical application.

Lab Outcomes: At the end of the course, the student will be able to

1. **Analyze and apply** fundamental programming constructs in C using Code::Blocks IDE to develop, compile, debug, and execute programs that implement input/output operations, operators, and control flow structures such as branching, looping, and nested decisions.
2. **Apply and evaluate** the use of functions, recursion, and arrays (including strings) in C programming to design modular and efficient programs that demonstrate data management and manipulation.
3. **Analyze and implement** advanced C programming concepts including structures, pointers with dynamic memory allocation, manage complex data efficiently in real-world applications.
4. **Apply and analyze** core object-oriented programming concepts in C++ including classes, objects, constructors/destructors, and implement polymorphism to develop reusable and efficient code.
5. **Analyze and implement** advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions to create flexible and extensible software designs.
6. **Design, implement, and evaluate** a C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and



R-2025- F.E. Information Technology

processing.

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	To understand the structure and features of the Code::Blocks Integrated Development Environment (IDE) and to use it effectively for writing, compiling, debugging, and executing C and C++ programs, which will serve as the foundational tool for all further experiments in the lab.	2
02	a) Program to demonstrate operations of Data Input and Output – getchar(), putchar(), scanf(), printf(), gets(), puts() b) Program to demonstrate Operators-Arithmetic, Relational and logical, Assignment, Unary, Conditional, Bitwise, Comma, other operators.	2
03	Program to demonstrate Branching - If statement, If-else Statement, Multiway decision.	2
04	Program to demonstrate Nested control structure- Switch statement, Continue statement, Break statement, goto statement	2
05	Program to demonstrate Looping – for and nested for loop	2
06	Program to demonstrate Looping – while, do-while	2
07	a) Implement an iterative function for factorial/ Fibonacci etc. b) Implement a recursive function for factorial/ Fibonacci etc.	2
08	Program to demonstrate Array 1D	2
09	Program to demonstrate Array 2D	2
10	Program to demonstrate String and arrays of string.	2
11	Program to demonstrate Structure: Write a program to store and display information of a student/employee etc. using structures a) Define a structure, b) Read and store details, c) Display the stored information.	2
12	Program to demonstrate call by value and call by reference.	2
13	Program to demonstrate the use of classes and objects, constructors and destructors in C++	2
14	Program to demonstrate Single, multilevel, and hybrid inheritance using classes	2
15	Create a system that stores and displays student records including name, roll number, marks for 3 subjects, and computes total marks, average, and grade. Implement the following: 1. A base class Person with attributes: name, roll_no 2. A derived class Student with: Subject marks (e.g., marks[3]) 3. Member functions to input and display data 4. Functions to calculate total, average, and assign grade 5. Use constructors for initialization and destructors to display a message	2

*R-2025- F.E. Information Technology*

	upon object destruction. 6. Use function overloading for displaying summary (e.g., detailed vs short view). 7. Implement operator overloading (e.g., == to compare two students by roll number or marks). 8. Use virtual function in a base class ResultCalculator and override in Student class. 9. Use an array of objects to manage multiple student records.	

Sr No	List of Assignments / Tutorials	Hrs
01	Flowcharts for programs, input/output operations, operators, and control flow structures such as branching, looping, and nested decisions	2
02	Use of functions, recursion, storage classes, and arrays (including strings) in C programming	2
03	Structures, pointers with dynamic memory allocation, and file handling	2
04	Core object-oriented programming concepts in C++	2
05	Advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions	2
06	C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing	2

Text Books

1. "Programming in C", by Pradeep Dey and Manas Ghosh, Oxford University Press.
2. "Object Oriented Programming with C++" by E. Balagurusamy, McGraw Hill Education.
3. "Basics of Computer Science", by Behrouz Forouzan, Cengage Learning.
4. "Programming Techniques through C", by M. G. Venkateshmurthy, Pearson Publications.
5. "Programming in ANSI C", by E. Balagurusamy, Tata McGraw-Hill Education.
6. "Let Us C", by Yashavant Kanetkar, BPB Publications.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Reference Books

1. "The C Programming Language" by Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall.
2. "Programming: Principles and Practice Using C++" by Bjarne Stroustrup, Addison-Wesley
3. "C Programming: A Modern Approach" by K. N. King, W. W. Norton & Company.
4. "C Primer Plus" by Stephen Prata, Addison-Wesley Professional.
5. "Programming in C" by Stephen G. Kochan, Addison-Wesley Professional

Online Resources:

Sr. No.	Website Name
1	Learn C - This website offers a free, interactive tutorial to learn C programming, covering both basic and advanced topics.
2	Codecademy - Codecademy provides a comprehensive, interactive course for learning C, complete with real-world projects and skill paths.
3	Coursera - Coursera, in collaboration with Duke University, offers a specialization in C programming, including hands-on projects and a certificate upon completion.
4	edX - This course, offered by edX, covers C programming with a focus on Linux, including professional certification.

Assessment:

- **Term Work:** Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.
- **Term Work Marks:** 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)
- **Practical & Oral Exam:** An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122110	IDEA LAB -1(Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122110	IDEA LAB -1(Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



R-2025- F.E Information Technology

Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
 - Internal assessment panel will collaborate to align project components with subject learning outcomes.
-

c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

- 1. Motivating and Inspiring Students**
 - Encourage students to take ownership of their learning and projects.
 - Cultivate a mindset of curiosity, exploration, and social relevance.
 - Foster an environment where students feel empowered to take creative risks.
- 2. Conducting Brainstorming and Ideation Sessions**
 - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
 - Promote collaborative thinking, design exploration, and interdisciplinary integration.
- 3. Arranging Guest Lectures and Expert Talks**
 - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
 - Facilitate exposure to real-world challenges, current trends, and future opportunities.
- 4. Ensuring Uniqueness and Originality of Projects**



R-2025- F.E Information Technology

- o Actively review proposed ideas to ensure **no duplication of solutions** across students.
- o Encourage students to explore novel approaches, technologies, and perspectives.
- 5. **Promoting Discussion and Collaborative Learning**
 - o Create platforms for students to present, discuss, and receive peer and mentor feedback.
 - o Facilitate idea refinement through regular discussions and group engagement.
- 6. **Aligning Subject Content Beyond Syllabus**
 - o Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
 - o This ensures relevance, depth, and meaningful interdisciplinary integration.
- 7. **Same Semester Faculty Requirement**
 - o Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
- 8. **Monitoring and Documentation**
 - o Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
 - o Provide ongoing feedback and ensure project alignment with learning outcomes.
- 9. **Coordination with Subject Faculty**
 - o Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
 - o Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab Aspect

Implementation Strategy

Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.
Mentoring Role	Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Aspect	Implementation Strategy
Capacity Building	Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.
Assessment Contribution	Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.
Recognition & Incentives	Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.

b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.
Independent Evaluation	Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a separate 25 marks allocated for termwork based on subject application.
Evidence Sources	Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.
Outcome Assurance	Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.

**Implementation Notes:**

- Guide faculty assess their course's contribution using specific evidence such as:
 - Logbooks
 - Subject-specific outputs (e.g., simulations, designs)
 - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)**Presentation-Based Assessment Structure (Total: 25 Marks)**

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15412111	Workshop I	--	--	2	--	--	30	15	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15412111	Workshop I	--	--	--	--	25	---	25

Lab Objectives:

1. To learn the basic concepts in electronic circuits.
2. To learn and perform steps of PCB fabrication.
3. To develop foundational skills in computer hardware assembly.
4. To understand maintenance, troubleshooting, and managing computer networks.
5. To explore and develop proficiency in using Google Workspace tools and to create and publish a functional website using Google Sites.
6. To develop practical skills in using Microsoft Excel and to study and execute AI-powered features in Microsoft Excel.

Lab Outcomes: At the end of the course, the student will be able to

1. Able to understand basic components of electrical components.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)*R-2025- F.E. Information Technology*

2. Able to demonstrate the process of PCB fabrication.
3. Able to assembling and disassembling a personal computer.
4. Able to solve common trouble shooting problem and common hardware issues.
5. Able to navigate and utilize core google workspace and integrate google workspace tools into a google sites.
6. Able to use basic to advance excel function and to use AI-powered features in Excel.

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
1	Introduction to PCB	Electronic Components and tools for measuring and debugging electronics circuits. • Active and Passive components • Breadboard to built simple circuits. • Soldering Practices. • Reading and interpreting circuit diagrams • Multimeter • Oscilloscope 8050 and DS0 • Function generator • Logic Probe/logic analyzer (demo) PCB Design and fabrication • Wiring system • Go-down wiring • House Wiring • Staircase wiring • Introduction To PCB design Software • Drawing a simple schematic • PCB layout and routing techniques.	6 6	LO1,L02
		Self- Learning 1. Component Identification and Research (real –life example). 2. Resistor Color Code Practice (learn resistor color code system) 3. Datasheet Study (Download the datasheet for any 1 component and identify write configuration) 4. Breadboard Familiarization (Watch a tutorial or read a guide on how a breadboard works.)	5	
2	Hardware and Networking	Introduction to Computer Hardware • Computer Fundamentals	6	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

		Introduction to computers Types of computer Components of computer Input/output devices Storage devices - Computer Hardware Motherboard architecture Processor types and features RAM types and installation Power supply and units Assembling a computer BIOS/UEFI Configuration Common Troubleshooting issues Installation of LINUX/WIN 11 (DUAL) VM WARE (Installation) Bootable PD (Installation) Google Workspace and Google sites - Introduction to google Workspace - Gmail, Email etiquette, labels, filters - Google Drive : Upload, organize, share - Google Docs/slides: Collaborate in real time, insert images, comments and tables. - Google Forms - Getting Start with Google Sites - Building basic website - Creating Multiple pages Microsoft Excel For Engineers and integrate with AI - Excel interface, data entry, formatting basics - Formulas and fabrication - Charts and graphs - Data sorting and filtering - Getting started with Excel - Data Analysis and visualization - AI in Excel	4 4 4	L03 L04 L05 L06



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

		Self Learning 1. Study and Report on Motherboard Components and Layout 2. Create a Maintenance Plan for a Personal Computer 3. Research BIOS/UEFI Functions and Configuration Options (Provide screenshots and describe real-world use cases. 4. Design a Small Office/Home Office 5. Create and Share a Collaborative Google Doc 6. Organize Files and Folders in Google Drive 7. Design a Mini-Website for a School Club, Event, or Business Idea	10	

Reference Books

1. PCB Design for Beginners by Albert Kelly.
2. Computer Hardware and Networking by Rajiv Chopra.
3. Google Sheets for Beginners: A Practical Guide to Mastering Google Sheets by Nathan George.
4. Google Workspace User Guide by Oliver Kent.

Online Resources

Sr No	Reference
1	https://onlinecourses.swayam2.ac.in/cec25_cs10/preview Computer Fundamentals, By Prof. Sanjay Tanwani.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

2	https://onlinecourses.swayam2.ac.in/nou25_cs01/preview -CIT-001: Fundamentals of Computer Systems, By Dr. Mangala Prasad Mishra
3	https://onlinecourses.swayam2.ac.in/aic20_sp59/preview -ESim - EDA tool for circuit design, simulation, analysis and PCB design, By Prof Kannan Moudgalya
4	https://onlinecourses.nptel.ac.in/noc25_ee163/preview -Electronic Systems Design: Hands-on Circuits and PCB Design with CAD, By Prof. Ankur Gupta
5	https://onlinecourses.swayam2.ac.in/imb25_mg206/preview Excel for Finance - From Basics to Advanced, By Dr. Premalatha K P

Suggested list of Experiments:

Sr No	List of Experiments	Hrs.
01	PCB Design and Fabrication.	6
02	Assembling and disassembling of computer. (Demonstration)	2
03	To solve Common Troubleshooting problem solving.	2
04	Installation of LINUX/WIN 11 (DUAL) (Demonstration)	2
05	To create a google form for simple survey or quiz.	2
06	To create grade sheets or expense tracker.	2
07	To built a basic Website and make resume and published on site.	2
08	To use excel and ChatGPT/Copilot.	2

Assessment for Term Work (25 marks)

- Term Work Marks: 25 Marks (Total marks)
- Job and Manual:- 20 Marks
- Regularity and active involvement:- 5 Marks

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98441112	Indian Knowledge System	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98441112	Indian Knowledge System	20	20	40	60	2.5	--	--	100

Rationale:

:

The Indian Knowledge System (IKS) is vital for preserving India's rich cultural heritage, fostering holistic and sustainable practices, and integrating ancient wisdom with modern science to address contemporary challenges and enrich global knowledge.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Objectives:

1. To explore and understand the evolution of Indian scientific thought
2. To evaluate the historical and modern educational systems in our country.
3. To analyse sustainable practices in ancient India.
4. To know the richness of Indian Arts and Culture
5. To understand the contributions of Indian Scientists and Nobel Laureates
6. To understand the principles of good governance.

Course Outcomes:

1. Recognize the sources and concepts of the Indian knowledge system
2. Learn about our history of Indian ancient knowledge and its significance in the current scenario.
3. Demonstrate sustainable development in various fields like Science, Technology, agriculture, industry, architecture performing arts, etc.
4. Understand and appreciate the rich heritage that resides in literature
5. Learn about the ancient Bhartiya education system in comparison with the modern era
6. Showcase the multi-dimensional nature of IKS and its importance in modern

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	1. Students should have the foundational knowledge and skills necessary for a comprehensive understanding of IKS 2. Students should be familiar with the Indian Culture, Language, and History of Science and Technology in India.		



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

I	Introduction to The Indian Knowledge System (I.K.S.)	Basic knowledge and scope of IKS, IKS in ancient India and modern india,, Preservation of culture, tradition and Dharma through education. Sources of Education, Aim of Education, Curriculum, methods of learning, Reviving, Knowledge (Ancient Scientific Discoveries) Self-Learning Topics: Macaulay's Education Policy and Max Mullar Ideology in destroying Indian Tradition	5 5	CO2
II	Development of Scientific Thoughts in Ancient India	Development in Science, Technology, Astronomy, Mathematics, and Life Sciences – Life Science, Physiology, Ayurveda, etc. Discoveries during Ancient times Self-Learning Topics: Technological Innovations in Ancient India, Architecture and Engineering	5 5	CO1
III	Development of Arts & Culture in India	Development of Arts & Culture in India, Introduction to Ancient Architecture (Arts, Forts, Paintings, Sculpture, Temple architecture, etc.), Development in performing arts & culture: Music, Art of singing, Art of dancing, Natyakala, Cultural traditions and Folk arts Self-Learning Topics: Origin and Evolution of Indian Classical Music and Dance, Natyashastra by BharataMuni, Handicrafts and Decorative Arts	5 5	CO4
IV	Good Governance in Ancient India	Introduction to Indian religions,Moral and Ethical Governance,Vishva Kalyan through Vasudhaiva Kutumbkam,Principles of Good Governance about Ramayana, Mahabharat, Artha Sastra and Kautilyan State,Scientific Explanation of Vedic or traditional system of society for Good Governance Self-Learning Topics:Governance Models and Kingdoms, Court System and Judges, Crime, Punishment & Fairness	5 5	CO6
V	Contribution of Indian Scientist & Nobel Laureates	Baudhayan, Aryabhata, Brahmgupta, Bhaskaracharya, Varahamihira, Nagarjuna, Susruta, Kanada & Charak Rabindranath Tagore, C.V. Raman, Har Gobind Khorana, Mother Teresa, Subrahmanyam Chandrasekhar, Amartya Sen, V.S. Naipaul, Venkatraman Ramakrishnan, Kailash Satyarthi and Abhijit Banerjee	5	CO5



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		Self-Learning Topics: Indian Contributions to Global Science	5	
VI	Sustainable Practices in Ancient India	Agriculture, waste management, water conservation, forest conservation, architecture, urban planning, biodiversity preservation, etc Yoga, Pranayama, and meditation for health and well-being. Self-Learning Topics: Vaastu Shastra Principles, Minimalism and Non-materialism	5	CO3
		Total	60	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information

Text Books:

1. A.K Bag, History of technology in India (Set 3 vol), Indian Nation Science Academy, 1997.
2. An Introduction to Indian Knowledge Systems: Concepts and Applications, B Mahadevan, V R Bhat, and Nagendra Pavana R N; 2022 (Prentice Hall of India).
3. Ancient Indian Knowledge: Implications To Education System, Boski Singh; 2019
4. India's Glorious Scientific Tradition by Suresh Soni; 2010 (Ocean Books Pvt. Ltd.)
5. Indian Art: Forms, Concerns, and Development in Historical Perspective (History of Science, Philosophy and Culture in Indian Civilization), General Editor: D.P. Chattopadhyaya, Ed. By. B.N. Goswamy; 1999 Munshiram Manoharlal Publishers Pvt. Ltd.
6. Indian Knowledge Systems: Vol I and II, Kapil Kapoor and A K Singh; 2005 (D.K. Print World Ltd).
7. Pandey, K.K. Kriya Sarira Comprehensive Human Physiology, Chaukhambha Sanskrit series, Varanasi, 2018
8. Shukla Vidyadhar & Tripathi Ravidatt, Aayurved ka Itihas evam Parichay, Chaukhambha Sanskrit Sansthaan, New Delhi, 2017
9. Textbook on The Knowledge System of Bharata by Bhag Chand Chauhan; 2023 (Garuda Prakashan) 6. Pride of India- A Glimpse of India's Scientific Heritage edited by Pradeep Kohle et al. Samskrit Bharati; 2006
10. Traditional Knowledge System in India, Amit Jha
11. J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001.

R-2025- F.E Information Technology

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/explorer?searchText=iks
2.	https://iksindia.org/book-list.php
3.	https://iksindia.org/index.php

Assessment:

Internal Assessment:

Assessment consists of one class test of 20 marks, the first class test is to be conducted when approx. 50% syllabus is completed and second assessment will be of 20 marks based on field visit/case study report/PPT presentation. Duration of written test shall be one hour.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98462113	NSS & Civil Defense	-	-	4*	-	-	60	-	60	2

*:Students need to complete 60 hours throughout the semester as it is not possible to get 4 hours /week due to the dynamic schedule of the Government agencies.

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
98462113	NSS & Civil Defense	--	--	--	--	--	25	--	25

Rationale :

The National Service Scheme (NSS) is a central sector scheme of the Government of India aimed at developing the personality of students through community service. The NSS syllabus is designed with a strong rationale that aligns with the educational, social, and developmental goals of the nation. The NSS syllabus promotes the all-round development of students by instilling values such as discipline, leadership, empathy, and teamwork. It encourages experiential learning beyond the classroom, complementing academic education.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com

R-2025- F.E Information Technology

Course Objectives:

1. To Introduce National Service Scheme to learners and explain how it is used in current social studies.
2. To make the students aware of the need of having a foundation in social science and NSS.
3. To develop the personality of NSS volunteers through community service. It can enhance the personal growth and social skills of students.
4. To introduce students to social concepts and issues in society, as well as to get involved in resolving social issues.
5. To equip NSS volunteers with basic skills in civil defence, first aid, fire safety, and crowd management, enabling them to act as first responders during emergencies.
6. To build awareness, preparedness, and responsiveness among NSS volunteers to effectively assist in disaster situations.

Course Outcomes:

1. **Describe** the fundamentals and history of the National Service Scheme (NSS), with specific reference to its role in social work and nation-building.
2. **Demonstrate** understanding of NSS-related procedures, including organizational structure, volunteer enrollment, and activity planning.
3. **Participate** in community-based social service activities such as voter awareness drives, campus cleanup, tree plantation, and cyber safety campaigns.
4. **Develop** leadership, team-building, and project management skills through planning and executing NSS activities.
5. **Explain** the basic concepts of civil defence and disaster response mechanisms.
6. **Apply** practical skills in fire safety, first aid, and emergency management during simulated and real-life situations.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite			
I	Leadership & Personality development	Meaning, definition, qualities, and characteristics of a Leader. Meaning of personality, Dimensions of personality. Personality and Leadership nexus. Universal Human Values and Ethics for youths, Sustainable Development Goals	6	CO1



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

II	Activity Based Programmes	(Colleges can plan various social activities for learners and make a detailed report) Activities can be conducted throughout the academic year .Evaluation will be based on record keeping of the attendance of the learner.	10	CO2
III	Awareness based Programmes	Awareness Programmes such as Rally,Seminar, Workshops, poster making, theme based rangoli making , essay writing, slogan writing, quizzes ,Celebration of National and International days, Personality Development Programmes, Group Activities, etc.,	10	CO3
IV	Area Based Projects	Visit to Adopted villages, Swatchatha \Programme, Visit and Conserving Ancient monuments and heritage site, Socio Economic Survey of village/slum, Nature Camp, Environmental Education, Women Empowerment Programme, Health and hygiene programmes and Blood donation, Legal awarenessProgramme, Literacy Programme, Cyber theft awareness Water Conservation Programme and RWH,One Day Special Camp in a village (preferably in adopted village/Adopted areas/Slums/MR Schools etc).	14	CO4
V	Introduction to Civil Defence and Disaster Management	Definition and objectives of civil defence,Structure and functions of the Civil DefenceOrganization, Types of disasters: natural and man-made, Phases of disaster management: prevention, preparedness, response, recovery, NDMA (National Disaster Management Authority) and its role,Role of youth in disaster management	10	CO5
VI	Basics of Fire Safety and First Aid	Types of fires and fire extinguishers, Basic fire-fighting techniques, First aid for common injuries: bleeding, fractures, burns, CPR, Emergency numbers and response protocol, Evacuation techniques	10	CO6
		Total	60	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Text Books:

1. National Service Scheme Manual 2006, Government of India
2. Salunkhe P.B. Ed, Chhatrapati Shahu the Pillar of Social Democracy
3. National Service Scheme Manual, Govt. of India
4. Training Programme on National Programme Scheme TISS
5. Orientation Courses for N.S.S. Programme Officers, TISS

Online References:

Sr. No.	Website Name
1.	https://nssmu.in
2.	https://nss.gymkhana.iitb.ac.in/home

Assessment:

Termwork (TW) for 25 marks:

- Term Work (TW) will comprise a report submitted by the students, detailing the 60 hours of social service completed during the semester as per the assigned projects and activities.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

F.E Syllabus

SEM 2

PREFACE

Theme: Data-Driven Smart Solutions for Sustainable and Inclusive Communities

Grounded in the vision of the **United Nations Sustainable Development Goals (SDGs)**—particularly:

- **SDG 9** (Industry, Innovation and Infrastructure),
- **SDG 10** (Reduced Inequalities),
- **SDG 11** (Sustainable Cities and Communities), and

Keywords:

- Data-driven solutions
- Smart technologies
- Sustainable development
- Inclusive communities
- Digital innovation
- Climate-resilient infrastructure
- Social equity

Description:

This theme explores the transformative power of data, digital innovation in building communities that are inclusive, resilient, environmentally sustainable and advocates for the responsible use of technology to drive evidence-based decision-making to foster inclusive digital infrastructure, and ensure equitable access to services.

It highlights how data-driven smart solutions can enable cities and regions to tackle complex challenges— inequality, urbanization, and resource scarcity—while promoting human well-being and social equity.

The theme calls for scalable and ethical innovations, promotes cross-sector collaboration, participatory design, and open data ecosystems to empower communities—especially marginalized and underserved groups—to actively shape their futures.

Ultimately, **data-driven smart solutions** are not only tools for efficiency and growth, but also powerful enablers of **sustainable development, social justice, and long-term resilience**.

For UNSDG 9 (Industry, Innovation and Infrastructure)

The major **thrust areas** should focus on achieving data and digital innovation to build resilient, inclusive, and sustainable infrastructure and industrial growth.

These thrust areas directly support SDG 9 by:

- **Building resilient infrastructure** (urban planning, mobility, climate-resilient systems),
- **Promoting inclusive and sustainable industrialization** (MSME support, green zones), and
- **Fostering innovation** (startups, digital inclusion, data ecosystems).

For UNSDG 10 (Reduced Inequalities)

The major **thrust areas** should focus on Digital Inclusion for Marginalized Communities, Inclusive Urban Planning, Equity in Access to Health & Education, Gender-Inclusive Smart Policies, Accessible & Adaptive Civic Services

These thrust areas are designed to:

- **Reduce social and economic disparities** within and across communities,
- Ensure **equitable access to resources and opportunities** through technology,
- Promote **inclusive decision-making**, and
- Use data to **dismantle structural inequalities** in urban service delivery.

For UNSDG 11 (Sustainable Cities and Communities),

The major **thrust areas** should focus on Smart Urban Planning and Land Use Management, Smart and Sustainable Mobility, Efficient, Inclusive Public Services, Smart Waste Management, Community Engagement and Participatory Governance

These thrust areas directly support SDG 11 by promoting:

- **Inclusive, safe, and resilient urban development**,
- **Sustainable transport and resource-efficient infrastructure**, and
- **Stronger citizen participation** through smart governance and data democratization.

Local Problem Statements for Mira Road / Mira-Bhayander

1. Smart Water Distribution and Leakage Prevention

Mira Road is experiencing growing challenges in ensuring reliable and equitable water supply due to irregular distribution patterns and significant water loss from aging pipeline infrastructure. This results in widespread water wastage, supply inconsistencies across neighborhoods, and inefficient resource utilization. The water distribution network remains reactive and unsustainable, threatening the city's long-term water security and the well-being of its residents.

2. Traffic Congestion and Smart Mobility Challenges

Mira-Bhayandar is increasingly burdened by severe traffic congestion, particularly in high-density commercial and market areas, leading to delays, increased fuel consumption, and reduced quality of life for commuters. The city faces mounting challenges in ensuring safe, efficient, and sustainable transportation for its growing population.

3. Inefficient Waste Management and Public Cleanliness

Mira-Bhayandar faces persistent challenges in maintaining effective waste management and public cleanliness due to poor segregation practices, irregular waste collection, and inadequate infrastructure. These inefficiencies result in unhygienic conditions, overflowing bins, increased environmental pollution, and a growing burden on landfill sites and thus the city struggles to build a sustainable and clean urban environment.

4. Unregulated Noise Pollution in Sensitive Zones

Mira-Bhayandar is experiencing rising levels of unregulated noise pollution, particularly in traffic-congested corridors, densely populated residential areas, and near construction sites. Noise levels frequently exceed permissible limits set by regulatory authorities, leading to adverse health effects, reduced quality of life, and disruption in sensitive zones such as schools, hospitals, and residential neighborhoods. Thus noise pollution remains an overlooked yet growing environmental and public health concern in the city.

5. Underutilized Public Health and Civic Grievance Systems

In Mira-Bhayandar, public engagement with civic grievance redressal and health monitoring systems remains low due to inefficient, manual processes and lack of real-time communication. Existing complaint mechanisms are often slow, non-transparent, and disconnected from timely resolution workflows, leading to citizen dissatisfaction and diminished trust in local governance. Thus the city struggles to provide responsive civic services and proactive public health management, ultimately affecting urban resilience and community well-being.

6. Low Community Participation in Environmental Initiatives

Environmental initiatives in Mira-Bhayandar—such as tree plantation drives, recycling programs, and energy conservation campaigns—frequently suffer from low levels of community participation. This is largely due to inadequate communication, lack of awareness, and the absence of accessible digital platforms that enable citizen engagement, volunteer coordination, and real-time tracking of environmental efforts. Strengthening public participation is essential for building an environmentally conscious and actively involved urban community.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15111201	Probability, Statistics, and Differential Equations	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
15111201	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	--	125

Rationale

This course provides Information Technology Engineering students with a solid foundation in essential mathematical concepts and techniques that support advanced computing, data analysis, and system modeling. It begins with differential equations (first-order and higher-order), which are vital for modeling processes such as signal processing, network behavior, and algorithm performance analysis. The study of double integrals introduces students to multivariable calculus, useful in areas like computer graphics, machine learning optimization, and physical simulations. Probability distributions equip students with tools to model and analyze uncertain or random events—key in fields such as cybersecurity, artificial intelligence, and data analytics. Through statistics and statistical techniques, students learn to make data-driven decisions by analyzing trends, variability, and correlations—core competencies in software engineering, database systems, and user behavior analysis. Finally, the inclusion of numerical methods prepares students to develop and apply computational algorithms to solve complex mathematical problems efficiently, supporting areas such as simulations, real-time systems, and numerical computing.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

This course bridges theoretical understanding and practical skills, enabling IT engineering students to apply mathematical reasoning effectively in modern computing environments.

Course Objectives:

1. To introduce solving differential equations to model real-world IT system dynamics.
2. To teach evaluation of double integrals for calculating quantities over regions.
3. To introduce fundamental probability distributions for modeling randomness.
4. To develop skills to summarize and interpret datasets statistically.
5. To introduce inferential statistics for data-driven decision making.
6. To enable students to apply numerical techniques to solve mathematical problems computationally.

Course Outcomes:

1. Students will be able to solve differential equations and use SCILAB to model processes like network traffic and signal processing.
2. Students will be able to evaluate double integrals and use SCILAB to analyze multi-dimensional data or resource allocation.
3. Students will be able to apply probability distributions and use SCILAB to model and analyze uncertainty in IT systems.
4. Students will be able to interpret statistical measures and use SCILAB to assess system performance and user data.
5. Students will be able to analyze data using hypothesis testing and regression and use SCILAB to optimize IT system performance.
6. Students will be able to implement numerical methods and use SCILAB to approximate solutions in algorithm analysis and simulations.

Prerequisite:

1. Basics of integration and it's properties.
2. Linear differential equations



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Differential Equation	Exact differential Equations, Equations reducible to exact form by using integrating factors.	05	CO1
		Equation reducible to linear form, Bernoulli's equation.		
		Linear Differential Equation with constant coefficient-complementary function, particular integrals of differential equation of the type $f(D)y = X$ where X is e^{ax} , $\sin(ax + b)$, $\cos(ax + b)$, x^m .		
		Self-learning topics: 1. Method of variation of parameter 2. Particular integrals for $e^{ax}V$ and xV . 3. Cauchy's homogeneous linear differential equation. 4. Legendre's differential equation. 5. Applications of first order and first degree and also Higher order differential equation.	08	
II	Multiple Integral	Beta and Gamma functions and its properties.	05	CO2
		Double integration-definition, Evaluation of Double Integrals. (Cartesian & Polar)		
		Change the order of integration (No Evaluation)		
		Self-learning topics: 1. Rectification of curves. (Cartesian, Polar and Parametric) 2. Application of double integrals to compute Area and Mass of lamina.	07	
		Discrete distribution: Poisson distribution		



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

III	Probability Distribution	Continuous distribution: Uniform, Exponential and Normal distributions.	05	CO3
		Self-learning Topics: 1. Skewness and Kurtosis of distribution (data). 2. Discrete distribution: Bernoulli and Binomial. 3. Conditional probability, joint probability, total probability and Bayes' theorem	07	
IV	Statistics	Discrete and continuous random variable with probability mass function and probability density function.	05	CO4
		Expectation, Variance, Moment generating function, Raw and central moments up to 4 th order.		
		Central limit theorem.		
		Self-learning Topics: 1. Time Series Analysis 2. Index Numbers 3. Decision Theory	07	
V	Statistical Techniques	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	05	CO5
		Lines of regression		
		Fitting of first- and second-degree curves.		
		Self-learning Topics: 1. Karl Pearson's Coefficient of correlation(r). 2. Fitting of exponential curve. 3. Fitting of logarithmic curve. 4. Covariance 5. Sampling theory for quantitative and qualitative samples.	08	
VI	Numerical Methods	Numerical integration-by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all without proof)	05	CO6



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		Interpolation by Newton's and Lagrange polynomials		
		Numerical solutions of transcendental equations by Newton Raphson method and Regula –Falsi method.		
		Self-learning topics: 1. Indeterminate forms, L- Hospital Rule, 2. Gauss Elimination Method, Gauss Jordan Method. 3. Maclaurin Series 4. Numerical solution of ordinary differential equation using (a) Euler's method (b) Modified Euler method, (c) Runge-Kutta fourth order method	08	

Text Books:

1. Operations Research, Hira and Gupta, S. Chand Publication.
2. Fundamentals of Statistics, S. C. Gupta.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
4. Murray Spiegel, "Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Operations Research: An Introduction, Hamdy A Taha, Pearson.
4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell

R-2025- F.E Information Technology

Online References:

Sr. No.	Website Name
1.	https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/
2.	https://www.youtube.com/watch?v=KgItZSst2sU
3.	https://nptel.ac.in/courses/117103017
4.	https://ocw.mit.edu/courses/res-6-012-introduction-to-probability-spring-2018/
5.	https://archive.nptel.ac.in/courses/117/103/117103017/
6.	https://archive.nptel.ac.in/courses/111/102/111102111/
7.	https://www.youtube.com/playlist?list=PLyqSpQzTE6M_JcleDbrVyPnE0PixKs2JE

Assessment:

Term work (TW) for 25 marks:

1. Batch-wise tutorials are to be conducted.
2. Students must be encouraged to write SCILAB Programs in tutorial class only. Each Student has to write **at least 5 SCILAB tutorials** (including print out) and **at least 10** class tutorials on entire syllabus.
3. SCILAB Tutorials will be based on entire syllabus

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks

R-2025- F.E Information Technology

2. Class Tutorials on entire syllabus 10 marks
3. SCILAB Tutorials 10 marks



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15111202	Modern Physics	2	--	--	--	30	-	30	60	2

Course Code	Course Name	Theory					Term work	Practical	Tutorial	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)				
		IAT 1	IAT 2	Avg.						
15111202	Modern Physics	20	20	40	60	2.5	-	-	-	100

Rationale:

1 Engineering Physics provides a strong grounding in fundamental concepts like mechanics, electromagnetism, thermodynamics, and optics, which are essential for understanding the scientific basis of all engineering disciplines.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- F.E Information Technology

2. The syllabus supports key subjects in all branches—such as strength of materials in civil and mechanical, circuits in electrical and electronics, and semiconductor physics in computer and IT—ensuring a smooth transition to branch-specific learning.
3. Physics fosters logical thinking, mathematical modelling, and problem-solving skills that are crucial for engineering analysis, system design, and innovation in every branch of engineering.
4. Topics like quantum mechanics, nanoscience, and wave phenomena prepare students for future technologies and interdisciplinary fields such as AI, robotics, renewable energy, and smart infrastructure, relevant across all engineering domains.

Course Objectives:

1. To build a foundation of quantum mechanics needed for modern technology.
2. To demonstrate principles of interference in thin film and diffraction..
3. To provide students with a basic understanding of laser operation basics of Optical fiber and its use in communication technology.
4. To explain basic working principle of Image sensors and their use and fundamentals of image processing.
5. To introduce the basic principles of sensors and familiarize learners with their role and applications in modern technological systems.
6. To give exposure to the concept of Fermi level in semiconductors.

Course Outcomes: Student will be able to –

1. Learner will be able to RELATE the foundations of quantum mechanics with the development of modern technology
2. Learner will be able to DEVELOP understanding of interference and diffraction; connect it to few engineering applications.
3. Learner will be able to ILLUSTRATE and APPLY the use of laser and OFC in engineering applications
4. Learners will be able to MEASURE Chromaticity and ILLUSTRATE color matching Concept..
5. Learner will be able to IDENTIFY the fundamentals of sensors and their applications in Advanced Technology.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

6. Learner will be able to CLASSIFY semiconductors and EXPLAIN variation of Fermi level with temperature and doping concentration.

Prerequisite: (For Theory Course):

1. Basic concepts of optics, including reflection, refraction, and interference using wave front analysis.
2. Application of Huygens' Principle and Snell's law in understanding light propagation.
3. Introduction to modern physics: dual nature of radiation, photoelectric effect, and matter waves.
4. Davisson–Germer experiment demonstrating wave nature of electrons.
5. Fundamentals of semiconductors: intrinsic and extrinsic types, electrical conductivity and resistivity.
6. Essential mathematical tools: vector algebra and partial differentiation used in physical analysis.

DETAILED SYLLABUS:

Sr. No.	Name of Module	4Detailed Content	Hours	CO Mapping
I	QUANTUM PHYSICS AND COMPUTING FUNDAMENTALS	Introduction (Matter waves, De Broglie hypothesis, Wave Packet). Concept of Phase velocity and group velocity and relation with particle velocity. Heisenberg Uncertainty Principle. Wave function; Physical interpretation of wave function. Schrodinger's time dependent wave equation; time independent wave equation; Particle trapped in one dimensional infinite potential well.	06	CO 1

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		Basics of Quantum Computing, Comparison of Classical computing & Quantum computing, Concept of Qubits, Quantum Superposition Quantum Entanglement.		
		Self-learning Topics: Quantum Tunneling and real-life examples Operators in Quantum Mechanics (basic idea) Quantum States and Measurement concept Basic Quantum Gates (NOT, Hadamard, CNOT) Quantum Teleportation (concept only) Quantum Cryptography and secure communication	06	
II	OPTICS FOR ENGINEERS	Thin Film Interference: Introduction (division of amplitude & Stoke's relation) Interference in thin film of constant thickness in reflected light, Formation of colors in thin film; Interference in Wedge shaped film in reflected light; Formation of Newton's rings; Applications Diffraction: Introduction to Fraunhofer diffraction at single slit, Amplitude equation of double slit, Diffraction Grating (N slits),	05	CO 2
		Self-learning Topics: Concept of Antireflecting coating, Highly reflecting films, Uses of Thin films, Measurement of optical flatness. Determination of refractive index of liquids using interference,	05	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		Determination of wavelength of light using plane transmission grating and numerical,.		
III	PHOTONICS: LASERS, AND FIBER OPTIC SYSTEM	Laser: Spontaneous emission and Stimulated emission; Metastable state, Resonant cavity, Population inversion, three & four level lasers, types of pumping, Semiconductor Laser. Nd-YAG laser.	06	CO 3
		Fiber optics: Structure of an optical fiber, Types: Single mode & Multimode, Numerical Aperture for step index fiber Modes of propagation, V number Self-learning Topics: Attenuation, Losses in Optical fiber due to Physics structure and Transmission of signal Application: Optical fibre Transmission, Holography, Barcode reader, LiDAR, Memory reading and writing applications.	06	
IV	OPTICAL IMAGING	Imaging sensors CCD, CMOS. construction and working , Image formation .(Monochrome and Colour), Chromaticity diagram , Chromaticity coordinates, Colour Measurement & colour matching	04	CO 4
		Self-learning Topics: various optical imaging techniques, advantages and challenges of optical imaging, and the application of deep	04	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

		learning and advanced computational methods.		
V	PHYSICS OF SENSORS FOR IoT APPLICATIONS	Ultrasonic sensors: Concept of inverse piezoelectricity, Ultrasonic transducer as distance meter, Applications Light sensors: Photodiode & LDR (Principle, working & Applications) Hall sensor: (Principle of Hall effect, working & Applications)	04	CO 5
		Self-learning Topics: IR sensor: (Principle, working & Applications) Motion and proximity sensors – Accelerometers and gyroscopes	04	
VI	SEMICONDUCTORS FOR COMPUTING	Types of semiconductors, Fermi Dirac Distribution Function. Fermi level of Intrinsic and Extrinsic Semiconductors, Equation of conductivity with current flow, Formation of p-n junction, p-n junction in forward Bias, p-n junction in Reverse bias, Current- voltage curve for p-n junction diode. Basics of BJT and MOSFET.	05	CO 6
		Self-learning Topics: Applications of semiconductor devices in computing hardware, including memory and modern VLSI trends like FinFETs.	05	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Text Books:

1. A Text book of Engineering Physics -Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, S. Chand,
1. Revised Edition 2014
2. Modern Engineering Physics - A. S. Vasudeva, S. Chand, Revised Edition 2013
3. Engineering Physics D. K Bhattacharya, Poonam Tandon, Oxford Higher Education, 1st
Edition 2015-16
4. Engineering Physics -R. K. Gaur, S. L. Gupta, Dhanpat Rai Publications, 2012
5. Engineering Physics -V. Rajendran, McGraw Hill Educations, 2017
6. A Textbook of Nanoscience and Nanotechnology, T. Pradeep Tata McGraw Hill Education
Pvt. Ltd., 2012

References:

1. Concepts of Modern Physics – Arther Beiser, Shobhit Mahajan, S. Choudhury, McGraw
Hill, 7th Edition 2017
2. Fundamentals of optics - Francis A. Jenkins, Harvey E. White, McGraw Hill Publication,
India, 4th Edition
3. Fundamentals of Physics, Halliday and Resnick, Wiley publication
4. Introduction to Electrodynamics, D. J. Griffiths, Pearson Publication
5. Handbook of Modern Sensors – Jacob Fraden, Springer, 5th Edition, 2016
6. Physics of Semiconductor Devices – S.M. Sze, Kwok K. Ng, Wiley, 3rd Edition
7. Introduction to Imaging Systems – R. H. Sherr, Springer, 1st Edition, 2006
8. Digital Image Processing – Rafael C. Gonzalez, Richard E. Woods, Pearson Education,
4th Edition, 2018

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/115/102/115102124/
2.	https://archive.nptel.ac.in/courses/115/102/115102025/
3.	https://archive.nptel.ac.in/courses/115/105/115105132/

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

4	http://cs231n.stanford.edu/
5	https://www.mathworks.com/learn/tutorials/image-processing.html
6	https://www.analog.com/en/education/education-library.html

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
15121203	Engineering Graphics	2	-	-	30	-	-	-	30	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
15121203	Engineering Graphics	20	20	40	60	2.5	--	--	100

Rationale:

Engineering Graphics develops spatial visualization and technical drawing skills essential for modern computing applications. It bridges the gap between digital systems and the physical world, supporting areas like embedded systems, IoT, and robotics. The course enhances understanding of 3D modeling, essential for AR/VR, digital twins, and simulation-based tools. It prepares students to work effectively in interdisciplinary teams involving hardware-software integration. Concepts like projections and solid modeling are foundational for CAD software, PCB design, and interface development. It supports UI/UX development for 3D applications, gaming, and visualization platforms. Engineering graphics aids in documenting and communicating design ideas clearly and accurately. Overall, it fosters analytical thinking and design communication, crucial for innovation in intelligent computing systems.

Course Objectives

- 1 To impart and inculcate proper understanding of the theory of projection.
- 2 To impart the knowledge to read and interpret a drawing.
- 3 To improve the visualization skill.
- 4 To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
- 5 To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.

Course Outcomes

- 1 Apply basic concepts of geometrical constructions to create engineering curves.
- 2 Apply the basic principles of projections in Projection of Lines and Planes
- 3 Apply the basic principles of projections in Projection of Solids.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

- 4 Apply the basic principles of sectional views in Section of solids.
- 5 Apply the basic principles of projections in converting pictorial views into orthographic Views.
- 6 Apply the basic principles of projections in converting orthographic views into isometric drawing.

Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
	Pre-requisite	To draw basic geometric shapes like circle, pentagon, hexagon, and square with different orientation. Divide a line, circle, etc. into equal number of parts.	01	
1	Introduction to Engineering Drawing and Engineering curves	1.1 Introduction to Engineering Graphics and its significance in Engineering domain. 1.2 Types of Lines, Dimensioning Systems as per IS conventions. 1.3 Engineering Curves: Basic construction of Conics, Cycloid, Involute and Helix (cylinder only). Self-learning topic: - Explore the concepts of eccentricity, focus, vertex, axis, directrix - Explore other conics - ellipse, parabola and hyperbola using directrix-focus method	03 03	CO1
2	Projections of Points, Lines and Planes	2.1 Projections of points in all four quadrants as well as lying on the planes. 2.2 Projections of lines inclined to both the reference planes (Excluding Traces of lines). Simple application-based problems on projection of lines. 2.3 Projection of planes (only standard geometrical shapes like square, triangle, pentagon, circle, etc.) inclined to one of the reference planes only. Self-learning topic: - Explore the projection of lines for mixed quadrants - Explore the projection of planes for planes inclined to both the reference planes	05 05	CO2
3	Projections of Solids	3.1 Projections of solids with the axis inclined to one reference plane include prism and cylinder 3.2 Projections of solids with the axis inclined to both reference planes include pyramid, and cone (Use change of position or Auxiliary plane method) Self-learning topic: - Explore the cuboid and tetrahedron solids inclined to one or both the reference planes. - Explore the applications of solid projection in machine components, structure, and packaging and manufacturing.	06 06	CO3
4	Sections of Solids and Development of Surfaces	Sections of Solids Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to only one reference plane. Use change of position or Auxiliary plane method. Self-learning topics:	04	CO4

		- Explore the development of lateral surface for regular solids - Prism, Pyramid, Cylinder, & Cone - Explore the real-life application of solids cut with section planes inclined to one plane.	04	
5	Orthographic and Sectional Orthographic Projections	Fundamental concepts of orthographic and sectional orthographic projections like Positioning of quadrants, observer, horizontal, vertical and profile plane, symbol etc., Different orthographic views, First and Third angle method of projection, different section (cutting) plane, its representation, importance of sectional views, rib and web in section. Views of simple machine parts as per the first angle projection method recommended by I.S. for Orthographic and Sectional Orthographic projection Self-learning topics: - Explore the third angle method of projection for orthographic views. - Explore half sectional and offset sectional views - Practice simple machine components with half section and offset section	06 06	CO5
6	Isometric Views	Introduction to isometric projections and Fundamental concepts of Isometric projection - isometric and non-isometric lines, axes, and planes. Concept of isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views Self-learning topics: - Explore the concepts of isometric scale and isometric projection - Practice isometric projection of simple objects using isometric scale - Explore the isometric views and projections of holes and slots on an inclined plane	05 05	CO6

1. N.D. Bhatt, "Engineering Drawing (Plane and solid geometry)", Charotar Publishing House Pvt. Ltd.
2. N.D. Bhatt & V.M. Panchal, "Machine Drawing", Charotar Publishing House Pvt. Ltd.

1. Narayana, K.L. & P Kannaiah (2008), Textbook on Engineering Drawing, Scitech Publisher.
2. Prof. Sham Tickoo (Purdue University) & Gaurav Verma, "(CAD Soft Technologies).
3. Auto CAD 2012 (For engineers and Designers)", Dreamtech Press New Delhi.
4. Dhananjay A Jolhe, "Engineering Drawing" Tata McGraw Hill.

Sr. No.	Website Name
1	https://archive.nptel.ac.in/courses/112/105/112105294/
2	https://nptel.ac.in/courses/112103019
3	https://archive.nptel.ac.in/courses/112/102/112102304/



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211204	Data Structure	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211204	Data Structure	20	20	40	60	2.5	--	--	100

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

Rationale:

The Data Structures course enables students to design and implement efficient data handling techniques foundational for building **Data-Driven Smart Solutions for Sustainable and Inclusive Communities**. By applying linear and non-linear structures like arrays, linked lists, stacks, queues, trees, graphs, and hash tables, students develop real-world systems that support resilient infrastructure (SDG 9), inclusive digital access (SDG 10), and sustainable urban services (SDG 11).

Course Objectives:

1. Learn the purpose and significance of data structures, as well as their fundamentals.
2. Learn linear and nonlinear data structures, as well as how they are implemented.
3. Analyze the data structures, such as stacks, queues.
4. Learn the terminologies, types and various operations in Linked list.
5. Explore the fundamentals of Tree and learn about its operations and applications.
6. Explore the real time applications of various data structures.

Course Outcomes:

1. Recall and describe basic data structure concepts such as arrays, stacks, queues, linked lists, trees, graphs, and searching/sorting techniques.
2. Explain the operations and behavior of linear and nonlinear data structures like linked lists, stacks, queues, trees, and graphs.
3. Implement various data structures and associated algorithms to solve computational problems.
4. Analyze and compare the performance of algorithms using different data structures.
5. Evaluate appropriate data structures for solving real-world problems based on

R-2025- FE Information Technology

- problem characteristics and performance trade-offs.
6. Design and develop efficient solutions for real-life applications using suitable data structures and algorithms.

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Concepts of Functions, Recursion, Arrays, Pointers, Structures and C programming constructs.		
I	Introduction to Data Structures, Stacks and Queues	Introduction to Data Structures, Concept of ADT, Types of Data Structures- Linear, Nonlinear, Static, Dynamic and Operations on Data Structures. Introduction to Stack, Abstract Data Type (ADT) of Stack, Stack Operations, Array-based Implementation of Stack Introduction to Queue, Abstract Data Type (ADT) of Queue, Queue Operations, Array-based Implementation of Queue, Types of Queues: Circular Queue, Priority Queue, Introduction of	8	CO1, CO2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

		Double-Ended Queue (Deque).		
		Self-learning Topics: Circular Queue vs Linear Queue: Memory Efficiency and Overflow Handling. Stack and Queue in Backtracking Algorithms (e.g., Maze Solving, Sudoku Solver) Priority Queue and Its Role in Operating System Scheduling Real-World Applications of Stack and Queue in Computer Systems	10	
II	Linked Lists	Introduction to Linked Lists, Representation of Linked Lists, Comparison: Linked List vs. Array, Types of Linked Lists: Singly Linked List, Circular Linked List, Doubly Linked List, Insertion, deletion, update and copying operations with Singly linked lists, doubly linked lists and circular linked lists, Reversing a singly linked list.	9	CO1, CO2
		Self-learning Topics: Linked List		

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

		Implementation of Stack, Linked List implementation of Queue, Circular Queue, Double Ended Queue, Priority Queue.	9	
III	Trees	Introduction to Trees: Terminology, Types of Binary trees. Non-recursive Preorder, in-order and post-order traversal. Creation of binary trees from the traversal of binary trees. Binary search tree: Traversal, searching, insertion and deletion in binary search tree. Threaded Binary Tree: Finding in-order successor and predecessor of a node in threaded tree. Insertion and deletion in threaded binary tree. AVL Tree: Searching and traversing in AVL trees. Tree Rotations: Right Rotation, Left Rotation. Insertion and Deletion in an AVL Tree. B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node.	10	CO1, CO2

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

		B+ Tree, Digital Search Tree, Game Tree & Decision Tree		
		Self-learning Topics: Implementation of AVL and B+	8	
IV	Graphs	Introduction to Graphs: Undirected Graph, Directed Graph, graph terminology, Connectivity in Undirected and Directed Graphs. Spanning tree. Representation of graph: adjacency matrix, adjacency list, Transitive closure of a directed graph and path matrix. Traversals: Breadth First Search, Depth First Search.	6	CO3
		Self-learning Topics: Implementation of BFS, DFS	4	
V	Searching	Searching: Sequential Search, Binary Search. Hashing: Hash Functions: Truncation, Mid-square Method, Folding Method, Division Method. Collision Resolution: Open Addressing: Linear Probing, Quadratic Probing, Double Hashing, Separate Chaining Bucket Hashing.	6	CO4, CO5

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

		Self-learning Topics: Comparative Study and Implementation of Searching Techniques in Data Structures	4	
VI	Applications of Data Structures	Stacks: Conversion of Arithmetic Expressions using Infix, Prefix and Postfix Notations, Reversing a String/List, Parentheses Checker. Trees: Representing expressions using of Expression tree and Huffman Encoding.	7	CO5, CO6
		Self-learning Topics: Application of Queues: Scheduling, Round Robin Scheduling Applications of stack in Syntax Parsing Application of Graphs in Social Network Analysis Trees in File System Organization Heaps in Priority-Based Task Scheduling, Trees in compilers and calculator	11	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com

Text Books:

1. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, “Data Structures Using C”, Pearson Publication.
2. Reema Thareja, “ Data Structures using C”, Oxford Press.
3. E. Balagurusamy, “Data Structure Using C”, Tata McGraw-Hill Education India.
4. Richard F. Gilberg and Behrouz A. Forouzan, “Data Structures: A Pseudocode Approach with C”, 2ndEdition, CENGAGE Learning.

References:

1. Sahni Horowitz, Fundamentals of data structures in C, computer science press, 2008.
2. Jean Paul Tremblay, P. G. Sorenson, “Introduction to Data Structure and Its Applications”, McGraw-Hill Higher Education
3. Narasimha Karumanchi, Data Structures And Algorithms, 5th Edition,CareerMonk, 2016.
4. Robert Kruse, C. L. Tondo, Bruce Leung, “Data Structures and Program Design in C”, Pearson Publication.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/106/102/106102064/
2	Data Structure using C Programming - Course (swayam2.ac.in)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15112205	Modern Physics Lab	--	--	1	--	--	15	--	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15112205	Modern Physics Lab	--	--	--	--	25	--	25

Lab Objectives:

1. To BUILD a foundation of quantum mechanics needed for understanding and developing modern technology.
2. To DEMONSTRATE the principles of interference in thin films and relate them to optical phenomena.
3. To INTRODUCE the fundamentals of lasers and optical fibers along with their applications in communication technology.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



R-2025- FE Information Technology

4. To MEASURE and match colours using a colorimeter or spectrophotometer, and to capture and process microscopic images using optical microscopy techniques.
5. To UNDERSTAND the working principle of an ultrasonic distance meter and to MEASURE distances using ultrasonic wave propagation.
6. To provide students with a basic UNDERSTANDING of Semiconductors in the field of Basic Engineering.

Lab Outcomes:

LO1: Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology.

LO2: Learners will be able to DETERMINE the wavelength of light and EXPLAIN the interference phenomenon.

LO3: Learners will be able to ILLUSTRATE the use of lasers in applications and APPLY the fundamentals of fiber optics in modern communication technology.

LO4: Learners will be able to MEASURE colour, perform colour matching based on standards like CIE 1931, and understand the significance of colour in fields like display calibration and printing.

LO5: Learners will be able to OPERATE an ultrasonic sensor to measure distance accurately and EXPLAIN its working based on the time-of-flight principle of sound waves.

LO6: Learners will be able to have a fundamental UNDERSTANDING of semiconductors, including their properties, types, and applications in basic engineering.



R-2025- FE Information Technology

List of Experiments. (Minimum five experiments required)

Sr No	List of Experiments	Hrs	LO
01	Determination of Number of Lines in Diffraction Grating using He-Ne Laser	01	LO2
02	Determination of Radius of Curvature of Lens Using Newton's ring Set Up.	01	LO2
03	Determination of 'h' using LED/photocell	01	LO1
04	Determination of Divergence of LASER	01	LO3
05	Determination of Numerical of Aperture of OFC	01	LO3
06	Study of Hall Effect.	01	LO5
07	Measurement of Distance using Ultrasonic Distance Meter.	01	LO5
08	Colour Measurement and Colour Matching	01	LO4
09	Optical Microscopy Imaging and Image Processing	01	LO4
12	Study of IV characteristics of Photodiode	01	LO6
13	Study of IV characteristics of Semiconductor PN Junction Diode	01	LO6

Text Books and References:**1. Ajoy Ghatak – Optics**

Excellent explanation of diffraction, laser interference, and grating equations.

2. C.L. Arora – B.Sc. Practical Physics

Practical procedure and observation format for the experiment.

3. Jenkins & White – Fundamentals of Optics**4. Gerd Keiser – Optical Fiber Communications****5. R.S. Sedha – Applied Electronics****6. Digital CMOS Design by Sung-Mo Kang****Online Resources:**

Sr. No.	Website Name
1.	IEEE Xplore / Research Gate
2.	https://www.electronics-tutorials.ws/diode/diode_2.html
3.	https://circuitdigest.com .
4.	https://www.vlab.co.in/
5.	https://www.AMRITHA.vlab.co.in/



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Assessment:

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks Project
+ 5 Marks (Attendance)

Project work: The project is to be completed within one semester. Students must execute the project as per the plan submitted at the beginning of the semester. The project outcome can be a working model, a simulation model, or a study report leading to the anticipated conclusion. Evaluation will be based on the quality of work and adherence to the submitted plan. A proper assessment rubric will be used for awarding marks.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) Notional Learning Hour/30
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122206	Engineering Graphics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
15122206	Engineering Graphics Lab	--	--	--	--	--	25	25	50

Lab Objectives:

- 1 To impart and inculcate proper understanding of the theory of projection.
- 2 To impart the knowledge to read and interpret a drawing.
- 3 To improve the visualization skill.
- 4 To enable students to represent three-dimensional objects on a two-dimensional surface in a way that accurately conveys their shape, size, and orientation.
- 5 To acquaint students with representing internal features of a three-dimensional object by way of section that accurately conveys their internal orientation.
- 6 To impart basic AutoCAD skills.

Lab Outcomes:

- 1 Apply the concepts of Draw, Modify and basic concepts of ACAD to draw basic geometries and diagrams of simple engineering parts.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

- 2 Apply the concepts of layers, and dimensions to create engineering drawing for a part drawing.
- 3 Create, Annotate, Edit and Plot drawings using basic AutoCAD commands and features.
- 4 Apply the basic principles of projections in 2D drawings using a CAD software.
- 5 Apply basic AutoCAD skills to draw different views of a 3D object.
- 6 Apply basic AutoCAD skills to draw the isometric view from the given two views.

List of Experiments:

Component: 01 – ACAD Print outs (activities to be completed in the CAD Laboratory - All printouts to be the part of Term Work.)

Sr. No.	List of Experiments	Hrs	CO mapping
1	Redrawing simple machine parts as given (05 problems)	04	CO1, CO2, and CO3
2	Orthographic projections (with and without section) (05 problems)	04	CO4 and CO5
3	Isometric Drawing – 3 problems.	04	CO6

Component: 02 – Drawing Sheets

01	Two problems on Engineering Curves	02	CO1
02	Two problems each on Projection of Lines and Planes	02	CO2
03	Two problems on Projection of Solids	02	CO3
04	Two problems on Section of Solids with DLS	02	CO4
05	Two problems each on Orthographic and Sectional Orthographic projection	02	CO5
06	Two problems on Isometric projection	02	CO6

Component: 03 – A3 size Sketch book

Sr No	List of Assignments	Hrs	CO mapping
01	Engineering Curves. (2 problems)	01	CO1
02	Projection of Lines and Planes (2 problems each)	02	CO2
03	Projection of solids. (2 problems)	02	CO3
04	Section of solids (2 problems)	02	CO4
05	Sectional Orthographic and Orthographic Projections (2 problems each)	04	CO5
06	Isometric Drawing. (3 problems)	03	CO6

Assessment:

Term Work: Term Work shall include all the drawings, assignments, and printouts listed above.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Drawing sheets and ACAD printouts) + 10 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: Practical exam on ACAD will be held based on the above syllabus.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122207	Modern Programming Paradigms Lab	2	--	2	30	--	30	--	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122207	Modern Programming Paradigms Lab	--	--	--	--	25	25	50

Rationale :

This course introduces to modern programming languages—Python, Go, and TypeScript. By learning scripting, concurrency, frontend development, and API building, students gain practical exposure to real-world software development practices. The inclusion of Git, project structuring, and integration projects ensures students adopt industry-relevant workflows. This foundation prepares students for advanced technical subjects and future careers in web development, automation, and scalable system design.

Lab Objectives:

1. To **demonstrate** the basic syntax and execution of programs using Python, Go, and TypeScript in a configured development environment.
2. To **apply** Git version control and command line operations for efficient project management and code organization.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com

*R-2025- F.E Information Technology*

3. To **develop** a basic REST API using Python and Flask that returns JSON responses for client requests.
4. To **implement** a REST API in Go using concurrency features like Goroutines and Channels, demonstrating JSON data handling.
5. To **design** a simple web interface using TypeScript integrated with HTML and CSS, and connect it to a Node.js server.
6. To **integrate** a backend API (Flask or Go) with a TypeScript frontend and demonstrate complete data communication in a full-stack application.

Lab Outcomes: Students will be able to

1. **write** and **execute** simple programs in Python, Go, and TypeScript using VS Code and terminal tools.
2. **initialize**, **manage**, and **submit** code projects using Git and command line tools on local and remote repositories.
3. **create** a Flask-based REST API and **test** its functionality using Postman.
4. **develop** a concurrent REST API in Go that provides JSON responses to client requests.
5. Students will be able to **build** an interactive frontend with TypeScript and **develop** a basic server using Node.js and Express.
6. **connect**, **fetch**, and **display** data between backend APIs and frontend applications, achieving functional integration.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Introduction to Programming: Understanding basic concepts like algorithms, flowcharts, and pseudocode. Problem-Solving Skills: Ability to approach problems methodically and apply logical thinking to develop solutions.	--	--
I	Introduction to Modern Programming Languages	Overview of Programming Paradigms: Scripting, Compiled, Strongly Typed Introduction to Modern Languages: • Python for Scripting and APIs • Go (Golang) for Concurrency and System Applications • TypeScript for Frontend and Type-Safe JavaScript Development Comparison of Language Syntax, Performance, Use-Cases Development Environment Setup: VS Code,	8	LO1

*R-2025- F.E Information Technology*

		Terminals, Compilers		
II	Git, Project Structure & CLI Basics	Introduction to Version Control Systems Git Fundamentals: Initialization, Add, Commit, Push, Pull Working with GitHub: Repositories and Collaboration Command Line Basics (Windows/Linux) Structuring Code Projects for Scalability	10	LO2
III	Python for Scripting & Flask API Development	Python Refresher: Variables, Data Types, Control Flow, Functions File Handling and Automation Scripting Introduction to APIs and HTTP Protocol Basics Flask Framework for API Development: • Setting Up Flask • Creating Routes and Returning JSON Data • API Testing with Postman	12	LO3
IV	Golang & REST API Development	Golang Syntax and Programming Constructs Concurrency Concepts: Goroutines and Channels Building REST APIs using net/http Package JSON Handling in Go Comparative Study: Python Flask API vs Go REST API	12	LO4

*R-2025- F.E Information Technology*

V	TypeScript & Node.js Basics	Introduction to JavaScript Limitations and TypeScript Advantages TypeScript Fundamentals: Types, Interfaces, Classes Basic HTML/CSS for UI Development Integrating TypeScript with HTML Node.js and Express Basics for Server-Side Development	10	LO5
VI	Integration Project – Backend and Frontend Combination	Integrating Flask/Go Backend APIs with TypeScript Frontend Using Fetch API/Axios for Data Retrieval Dynamic Data Display on Web Interface Project Structuring for Full Stack Applications Basic Deployment Practices (Localhost)	8	LO6

List of Experiments.

Sr No	List of Experiments	Hrs
1	Write programs to understand 1. Install Python, Go, Node.js, and Visual Studio Code. 2. Write and Execute a "Hello World" Program in Python, Go, and TypeScript 3. Demonstrate Basic Data Types and Variables in all three languages 4. Implement a simple program for user input and output in Python, Go, and TypeScript 5. Compare Syntax for Conditional Statements (if-else) across Python, Go, and TypeScript.	8
2	Write programs to understand 1. Initialize a Git Repository and Create the First Commit 2. Create a GitHub Repository and Push Local Code to Remote	10

*R-2025- F.E Information Technology*

	3. Demonstrate Basic Git Operations: git add, git commit, git status, git push, git pull 4. Navigate Directories using CLI (cd, ls/dir, mkdir, rm) on Windows/Linux 5. Design a Standard Project Structure for Python, Go, and TypeScript Projects.	
3	Write programs to implement 1. Write a Python Script for Basic Arithmetic Operations with User Input 2. Develop a Python Script to Organize Files Based on File Extensions 3. Create a Flask API with a Single Route Returning JSON Data 4. Extend the Flask API with POST and GET Methods for Handling User Data 5. Test the Flask API using Postman and Analyze the API Responses	12
4	Write programs to implement 1. Write Basic Go Programs Demonstrating Variables, Data Types, and Loops 2. Implement a Go Program Using Goroutines to Run Multiple Tasks Concurrently 3. Demonstrate the Use of Channels for Communication Between Goroutines 4. Build a Simple REST API in Go Returning JSON Data Using net/http Package 5. Compare Response Time of Go API vs Python Flask API using curl or Postman	12
5	Write programs to implement 1. Write TypeScript Programs Demonstrating Type Annotations and Interfaces 2. Create a Basic HTML Page with TypeScript Performing DOM Manipulation 3. Develop a Simple Calculator or Form Validation Logic using TypeScript 4. Set Up a Node.js Server using Express and Return Static JSON Data 5. Create an Express API Handling GET and POST Requests in TypeScript	10
6	Write programs to implement 1. Connect Flask API with TypeScript Frontend Using Fetch API 2. Connect Go REST API with TypeScript Frontend and Display JSON Data 3. Implement Error Handling for Failed API Calls in Frontend 4. Demonstrate Complete Data Flow from Backend to Frontend (Full Stack Integration) 5. Team Presentation of Working Integrated Application	8



R-2025- F.E Information Technology

Sr No	List of Assignments / Tutorials	Hrs
1	Introduction to Modern Programming Languages	2
2	Git, Project Structure & CLI Basics	2
3	Python for Scripting & Flask API Development	2
4	Golang & REST API Development	2
5	TypeScript & Node.js Basics	2
6	Python for Scripting & Flask API Development	2

Text Books:

1. **Mark Lutz, Learning Python, 5th Edition, O'Reilly Media.**
(Comprehensive coverage of Python fundamentals, advanced data types, and functional programming.)
2. **Alan A. A. Donovan, Brian W. Kernighan, The Go Programming Language, Addison-Wesley.**
(Fundamental guide for Go language syntax, concurrency, and system programming principles.)
3. **Yakov Fain, Anton Moiseev, TypeScript Quickly, Manning Publications.**
(Beginner to intermediate resource for TypeScript fundamentals, interfaces, classes, and project integration.)
4. **Jennifer Robbins, Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics, O'Reilly Media.**
(Essential introduction to modern web development, covering HTML, CSS, JavaScript, and visual design.)

References:

1. **Luciano Ramalho, Fluent Python, 2nd Edition, O'Reilly Media.**
Miguel Grinberg, Flask Web Development: Developing Web Applications with Python, O'Reilly Media.
(Step-by-step guide to building RESTful APIs and web applications using Flask framework.)
2. **Mihalis Tsoukalos, Mastering Go, Packt Publishing.**
(Advanced resource for Go programming with in-depth coverage of concurrency, networking, and real-world applications.)
3. **Scott Chacon, Ben Straub, Pro Git, 2nd Edition, Apress.**
(Comprehensive explanation of Git version control, collaboration workflows, and repository management.)
4. **Mario Casciaro, Luciano Mammino, Node.js Design Patterns, Packt Publishing.**
(In-depth exploration of Node.js architecture, design patterns, and production-grade backend development.)

Online Resources:

Sr. No.	Website Name
1.	Official Python Documentation – https://www.python.org/doc/
2.	Flask Framework Documentation – https://flask.palletsprojects.com/
3.	Official Go Documentation – https://go.dev/doc/
4.	Interactive Tour of Go – https://tour.golang.org/
5.	TypeScript Documentation – https://www.typescriptlang.org/docs/
6.	Node.js Documentation – https://nodejs.org/en/docs
7.	Git Documentation – https://git-scm.com/doc



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E Information Technology

Assessment:

Term Work: Term Work shall consist of at least 12 to 15 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15122208	IDEA LAB – 2 (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15122208	IDEA LAB – 2 (Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable,



socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.



- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

- 1. Motivating and Inspiring Students**
 - Encourage students to take ownership of their learning and projects.
 - Cultivate a mindset of curiosity, exploration, and social relevance.
 - Foster an environment where students feel empowered to take creative risks.
- 2. Conducting Brainstorming and Ideation Sessions**
 - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
 - Promote collaborative thinking, design exploration, and interdisciplinary integration.
- 3. Arranging Guest Lectures and Expert Talks**
 - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
 - Facilitate exposure to real-world challenges, current trends, and future opportunities.
- 4. Ensuring Uniqueness and Originality of Projects**
 - Actively review proposed ideas to ensure **no duplication of solutions** across students.
 - Encourage students to explore novel approaches, technologies, and perspectives.
- 5. Promoting Discussion and Collaborative Learning**



R-2025- FE Information Technology

- Create platforms for students to present, discuss, and receive peer and mentor feedback.
- Facilitate idea refinement through regular discussions and group engagement.
- 6. **Aligning Subject Content Beyond Syllabus**
 - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
 - This ensures relevance, depth, and meaningful interdisciplinary integration.
- 7. **Same Semester Faculty Requirement**
 - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
- 8. **Monitoring and Documentation**
 - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
 - Provide ongoing feedback and ensure project alignment with learning outcomes.
- 9. **Coordination with Subject Faculty**
 - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
 - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.
Mentoring Role	Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.
Capacity Building	Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.
Assessment Contribution	Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.



R-2025- FE Information Technology

Aspect	Implementation Strategy
Recognition & Incentives	Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.

b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.
Independent Evaluation	Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a separate 25 marks allocated for termwork based on subject application.
Evidence Sources	Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.
Outcome Assurance	Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
 - Logbooks
 - Subject-specific outputs (e.g., simulations, designs)
 - Paper publications or review presentations

1) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

**a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)****Presentation-Based Assessment Structure (Total: 25 Marks)**

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)**Applicable to All Subjects Integrated with Interdisciplinary Projects**

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15212209	Data Structure Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15212209	Data Structure Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Learn about the purpose and importance of data structures, as well as their

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



R-2025- FE Information Technology

- principles.
2. Understand linear and nonlinear data structures, as well as their implementation.
 3. Analyze data structures, such as stacks and queues.
 4. Study the terminologies, types, and various operations in linked lists.
 5. Discover the principles of Tree, including its operations and uses.
 6. Investigate the real-time uses of different data structures.

Lab Outcomes:

- 1) Classify and apply linear and non-linear data structure concepts to real-world problem solving, as well as performing operations such as insertion, deletion, and traversal.
- 2) Explore data structures like Stacks, learn about their operations, and apply them to solve issues in a variety of domains.
- 3) Examine queue data structures and apply them to use in diverse real-world applications.
- 4) Apply the concept of linked lists to evaluate problems in a variety of applications
- 5) Analyze and apply the concepts of Trees and their applications in real life problem solving.
- 6) Demonstrate the ability to analyze, construct, implement, and use data structures to solve real-world problems and evaluate their effectiveness.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Implementation of Insertion and deletion in a specific position in an Array using Function.	2
02	Implementation of recursive program.	2
03	Array Implementation of Stack.	2
04	Array Implementation of Linear Queue.	2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

05	Array Implementation of Circular Queue.	2
06	Implement Singly Linked List.	2
07	Implement Doubly Linked List.	2
08	Implementation of Double Ended Queue using Linked List.	2
09	Implementation of Stack using Linked list	2
10	Implementation of Binary Search Tree and its traversal methods.	2
11	Program to count Number of leaf nodes, find the biggest and smallest and height of the tree.	2
12	Implementation of Reversing a List using Stack.	2
13	Convert an Infix expression to Postfix expression using stack ADT.	2
14	Program to Evaluate Postfix Expression using Stack ADT.	2
15	Implementation of DFS and BFS	2

Sr No	List of Assignments / Tutorials	Hrs.
01	Assignment covers the topics from first three units (Introduction, Stack and Queue) limited to three Questions	2
02	Assignment covers the topics from Last three units (Linked list, Tree and Application of Data Structures) limited to three Questions	2

Text Books:

1. Reema Thareja, "Data Structures using C", Oxford Press.
2. Aaron M Tenenbaum, Yedidyah Langsam, Moshe J Augenstein, "Data Structures Using C", Pearson Publication.
3. Ellis Horowitz, Sartaj Sahni, Fundamentals of Data Structures, Galgotia Publications; 2010.
4. E. Balagurusamy, "Data Structure Using C", Tata McGraw-Hill Education India.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE Information Technology

References:

1. Narasimha Karumanchi, Data Structures And Algorithms, 5th Edition, CareerMonk, 2016.
2. Jean Paul Tremblay, P. G. Sorenson, "Introduction to Data Structure and Its Applications", McGraw-Hill Higher Education.
3. Robert Kruse, C. L. Tondo, Bruce Leung, "Data Structures and Program Design in C", Pearson Edition.

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/102/106102064/
2.	Data Structure using C Programming - Course (swayam2.ac.in)

Assessment:

Term Work: Term Work shall consist all practical's based on the above list. Also, Term work Journal must include at least 2 assignments per subject.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15412210	Workshop II	--	--	2	--	--	30	15	45	1.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15412210	Workshop II	--	--	--	--	25	--	25

Lab Objectives:

1. To introduce students to basic IOT and embedded systems by programming a NODE MCU ESP8266 micro controller to blink an LED.
2. To understand the basic working principle infrared (IR) sensors and role in detecting line contrast.
3. To introduce students to fundamental robotics concepts through the assembly and programming of a basic line following robot.
4. To understand flight dynamics, sensor integration, remote control systems, and applications of drones in real-world.
5. To familiarize student with component and operation of 3D printer.
6. Identify different types of 3D printers (FDM, SLA, SLS) and their components.

Lab Outcomes: At the end of the course, the student will be able to

1. Able to collect data from sensors and control actuators using boards like Arduino, NodeMCU, or Raspberry Pi.
2. Able to Write and implement code to control robotic motion using microcontrollers like Arduino, Raspberry Pi, or other platforms.

*R-2025- F.E. Information Technology*

3. Able to design, implement, and test a line following robot that autonomously follows a predefined path using infrared (IR) sensors.
4. Able to Perform printer setup, filament loading, calibration, and execute the printing process successfully.
5. Able to understand the fundamentals of additive manufacturing and to fabricate a physical 3D model using Fused Deposition Modeling (FDM) technology.
6. Able to operate a drone using a remote controller and execute programmed missions using waypoint navigation.

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
1	Introduction to IOT and Embedded system	Programming a NodeMCU ESP8266 microcontroller to blink an LED. • Introduction to NODE MCU and IOT. • Circuit setup and IDE configuration. • Setting up Arduino IDE for ESP8266. • Experimenting Variation and Discussion	6	LO1
		Self Learning Connect the DHT sensor to the NodeMCU. Write and upload a program using Arduino IDE to read temperature data. Write and upload a program using Arduino IDE to read temperature data. Send the data to Thing Speak (or any IoT dashboard). Visualize the readings on a real-time graph.	4	
2	Introduction to Robotics	Programming a basic line following robots • Introduction to robotics and components • Assembling a line following robots • Programming the robot. • Testing and evaluation.	8	LO2 LO3
		Self Learning Build and Control a Basic Line-Following Robot (Modify the code to adjust speed based on curves.)	4	
3	Introduction to 3D Printing	To design and print your first object • Introduction and basics. • 3d modelling • Slicing and preparing the print • Printing and reviewing.	8	LO5 LO6

*R-2025- F.E. Information Technology*

		Self learning Explore process parameter of 3d printer Explore 2d and 3d drafting and modelling	4	
4	Introduction to drone technology	Introduction to drone • Components familiarizations • Drone assembly • Calibration and coding upload • Flight testing and troubleshooting Self Learning Studying basic principle of drone Studying drone programming Basic drone fundamentals	8 3	LO4

Reference Book

1. IoT: Building Arduino-Based Projects by Peter Waher.
2. Robotics: Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciavicco, Luigi Villani, Giuseppe Oriolo.
3. 3D Printing: A Practical Guide for Librarians by Sara Russell Gonzalez, Denise Beaubien Bennett.
4. Make: DIY Drones for the Evil Genius by Ian Cinnamon.

Online Resources

Sr No	Reference
1	https://onlinecourses.nptel.ac.in/noc21_cs17 -Introduction to internet of things, by Prof. Sudip Misra , IIT Kharagpur
2	https://onlinecourses.nptel.ac.in/noc21_cs08 -Embedded Systems Design, By Prof. Anupam Basu, IIT Kharagpur
3	https://onlinecourses.nptel.ac.in/noc25_ae30/preview -Drone Systems and Control, By Prof. Suresh Sundaram, Dr. Rudrashis Majumder
4	https://onlinecourses.swayam2.ac.in/ntr25_ed66/preview - 3D Printing and Design for Educators, By Dr. Sharad K. Pradhan

Suggested list of Experiments:



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Sr No	List of Experiments	Hrs.
01	Blinking LED with Node MCU.	8
02	Built and test basic Line following robot	8
03	Design and Print your first object.	8
04	To assemble and understand working of mini drone.	6

Assessment for Term Work (25 marks)

- **Term Work Marks:** 25 Marks (Total marks)
- **Job and Manual:-** 20 Marks
- **Regularity and active involvement:-** 5 Marks



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE – Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
98482211	Universal Human Values	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT2	Total					
98482211	Universal Human Values	-	-	-	-	-	25	-	25

Rationale: The goal of the education system is to cultivate well-rounded individuals who are capable of rational thinking and action, as well as empathy and compassion. It strives to nurture ethical values and principles, shaping responsible citizens who can contribute to creating an inclusive, equitable, and diverse society, as envisioned by our Constitution. Education should focus not only on intellectual growth but also on developing social, ethical, and emotional intelligence. Ultimately, education is essential for unlocking human potential and fostering a just and fair society. A fair combination of holistic and multidisciplinary education would develop human beings wide intellectual, deep aesthetic, social, physical, emotional, and moral in an integrated manner. UHV courses are intended to help students to develop a holistic, humane world vision for adopting fair technological advancements. The modules structured to be discussed are universal, rational, and verifiable, hence leads to harmony.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com

R-2025- FE – Information Technology

Course Objectives:

1. To develop a holistic perspective based on self-exploration about them (human being),
2. To understand the meaning of harmony in relationship family with reverence and compassion
3. To explore a wide range of social networking ensuring mutual happiness and prosperity
4. To identify the urge to establish global peace and harmony to make the world a better place to live.
5. To understand the threats posed by human activities to biodiversity, and provide solutions
6. To develop understanding in implementing technologies to serve mankind.

Course Outcomes: After successful completion of the course learner will be able:

1. Identify innate humanistic virtues and abilities as fundamentals to work as an individual.
2. Explore solutions to behavioral conflicts through family, a society in miniature with empathy.
3. Develop understanding to maintain human-human relationship for mutual happiness for building great teams.
4. Adapt for global pursuits in a peaceful co-existence with the entire mankind for global society uplift.
5. Acquire awareness of maintenance and conservation of biodiversity to provide sustainable solutions.
6. Evaluate the knowledge of 'Real Self' augmenting universal human order to develop holistic technologies and creating congenial work environments.

Prerequisite: There is no prerequisite for this course.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE – Information Technology

DETAILED SYLLABUS:

Sr. No	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	There is no prerequisite for this course.		
I	Holistic Growth of Individual	Understanding the Human Being: Body, mind, and self – their roles and needs, Distinction between the self (conscious entity) and the body, Importance of self-reflection and self-awareness Developing clarity about personal goals and values, Emotional intelligence: managing thoughts and feelings. Lifestyle choices that support well-being Integrating knowledge with ethics and values Self-Learning Topics: Analyze yourself thoroughly and discover your personality traits: Behavioral, Habitual and Acquired traits and record the significance of the traits in handling diverse situations in your past and present life.	4 4	CO1
II	Self-Harmony & Family Values	Prosperity - a right identification of needs and fulfillment through right means What is <i>naturally acceptable</i> (permanent, universal) vs. what is acquired or conditioned. Family - a space for value cultivation and emotional support, Mutual fulfillment addressing Common Family Issues: Balancing individuality and togetherness, Misunderstandings due to Assumptions, Generational gaps and communication barriers. Trust empathy, and open communication in family relationships. Family as a Basic Unit of Society, Joint versus nuclear family structures and their social impact. Self-learning Topics: Importance of Respect and. Compassion in families, relations, neighborhood, how family harmony helps to progress and attain a worthy and respectable social and financial status. Togetherness and advancement, Conflict and resolution	4 4	CO2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE – Information Technology

III	Social Equilibrium	Human-Human relationship, Respecting others and their perspectives, Understanding the difference between <i>intention</i> and <i>competence</i>. Vision of a universal human order (Sarvabhauma Vyavastha) based on trust and mutual prosperity. Promotion of dialogue, cooperation, and peaceful coexistence. Individuals and groups work together for common goals and shared well-being. Visualizing a universal harmonious order in society- Undivided Society, Universal Order from self to community Mutual Prosperity. Support and Empower marginalized communities Self-Learning Topic: A positive and unbiased Mediation and dialogue, and its importance Different communities' views for creating better communities & societies. Incidents happening around you which urgently require social equilibrium as a vision.	5 5	CO3
IV	Shared Values of Mankind	Values accepted and upheld by all human beings regardless of background, peaceful coexistence and global harmony. Role in addressing global challenges like conflict, inequality, and environmental crises, Philosophical and spiritual traditions worldwide. Human rights frameworks (e.g., Universal Declaration of Human Rights). Sensitizing individual towards Contemporary World Issues Self Learning Topic: India's relationships with other countries. Promoting peace and harmony hence preventing conflict situations. Conflict situations throughout the world where India as a one who maintained its integrity by following its traditional, philosophical and ethical standard.	6 6	CO4



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- FE – Information Technology

IV	Human-Nature Relationship	Humans as caretakers of the Earth, not conquerors. Ethical choices like wildlife conservation, habitat preservation, and reducing pollution. Promoting humane treatment in agriculture, research, entertainment, and daily life. Sustainable living: reducing waste, recycling, and using renewable energy. Educating communities about the importance of biodiversity and ecosystem health.	6	CO5
		Self-Learning Topics: Practices adopted in ancient India for preserving the environment, Importance of rivers, trees, water mentioned in Indian scriptures and culture. Modern technologies/practices favoring ecosystem preservation. (Past Practices Vs, Present Practice)	6	
VI	Integrating universal human values in the workplace	Meaningful and Purposeful Work: Encouraging dignity in all types of jobs. Human creativity and contribution to society. Equal opportunities without discrimination. Prioritizing human well-being over mere profit. Technical education is enriched with ethics and human-centric values. Ethical behavior includes not exploiting others for personal gain—whether as employers or consumers. Ability to identify and develop appropriate technologies and management patterns for production systems. Case studies of typical holistic technologies, management models and production systems. Self-Learning Topics: Contemporary workplace scenario Confronting challenges like globalization, technological advancement/disruption cultural diversity, workplace prejudice .unconscious bias. Hampering output and how universal human values helps erasing these complexities.	5 5	CO6

References:

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2009). *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
2. Ravindran, P. S. (2007). *Essence of Human Values and Professional Ethics*. Chennai: Sri Ramakrishna Math.
3. Gaur, R. R. (2011). *Human Values and Professional Ethics*. New Delhi: Dhanpat Rai Publishing Company.
4. Chitkara, M. G. (2002). *Education and Human Values*. New Delhi: A.P.H. Publishing Corporation.
5. Martin, M. W., & Schinzinger, R. (2005). *Ethics in Engineering* (4th ed.). New York: McGraw-Hill.
6. Gandhi, M. K. (1927). *The Story of My Experiments with Truth*. Ahmedabad: Navajivan Publishing House.
7. Vivekananda, S. (Compilation). (2001). *I and My Nation*. Kolkata: Advaita Ashrama.
8. AICTE (2020). *Towards a Holistic Development: A Collection of Good Practices in UHV*. New Delhi: All India Council for Technical Education.

Sr. No.	Website Name
1.	https://uhv.org.in/

Assignments	20 Marks

Attendance **5 Marks**

Conduct Group Speaking Activities to explore and comprehend the basic human and global society issues.

(In group speaking activity, especially, conduct discussions on Contemporary World Issues, Contemporary workplace challenges enabling students to think and suggest solutions on humanitarian ground)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

List of Assignments (Answer the questions about in 500 words)

1. Explain the process, content, and natural outcome of self-exploration with a neat diagram and two examples from your life.
2. Analyze the impact of compassion on mental health. Describe the role of family in the development of an individual.
3. Describe the concept of an undivided society and the universal order and explain how both these can help to create a world family.
4. What do we mean by holistic technologies, management models, and production systems? How are these useful for mankind?
5. Explain the concept of co-existence in nature. How can this understanding help in addressing environmental issues?
6. Design a program to promote respect in the workplace where people treat each other with respect and have equal opportunities for growth.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

Course Code	Course Name	Teaching scheme (Contact Hours)Per Week			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98421212	Corporate Communication	1	-	-	15		-	15	30	1

Course Code	Course Name	Theory					Term Work	Pract Exam	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98421212	Corporate Communication	20	20	40	40	1	-	-	80

Rationale:

The corporate communication course has been designed to train students for oral and written proficiency in an increasingly interconnected and digital corporate world. The engineers must be able to analyze intricate concepts & messages, understand communication theories, and develop practical skills in verbal, non-verbal, and digital communication. Effective communication skills are essential for corporates to express in panache inside organizations, with venture capitalists, strategic investors,

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

potential clients, and everyday users. It helps to create a brand image and manage organization reputation by open and transparent channels of communication through up skilling LSRW competencies (Listening, Speaking Reading and Writing)

. **Course Objectives** - The learners should be able to:

1. Effectively explore the dynamics of communication and navigate professional arenas
2. Competently acquire active listening skills by comprehending physical and digital content
3. Critically analyse communication barriers, audience and purpose to speak proficiently.
4. Minutely comprehend extensive texts, technical and non-technical, to execute relevant tasks
5. Efficiently organize and create purposeful technical writing for professional and Business transactions
6. Impactfully relate with other agencies with ethical standards to deliver synergistic solutions.

Course Outcomes - The learners will be able to:

1. Explore dynamics of communication for computer mediated communication in modern tech enabled workplaces
2. Acquire active listening skills by practicing technical and business Speech Acts via direct and digital mode.
3. Analyze barriers, methods, audience and purposes for mastering individual and team speaking in technical and professional settings
4. Synthesize extensive technical and non-technical texts for reflective learning through reading and summarization.
5. Design purposeful and ethical technical and business content, presentation using ICT enabled media.
6. Advocate technical excellence and use of modern technological tools for ethical & sustainable community solutions.
7. **Prerequisite:** Basic knowledge of English language



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of English language.		
I	Communication Dynamics	Foundations of Communication Dynamics: Objectives, Linear vs. Transactional Models Encoding, Decoding, and Feedback, , Interpersonal Communication in Groups: Verbal interaction Meetings & Presentations, , Teleconferences & Calls and Non-Verbal Interactions: Proxemics, Haptic Oculesics, Kinesics Digital Interaction: virtual teams video calls Formal and Informal communication Communication Channels . Barriers: Physical Semantic Psychological & Emotional Barriers Cultural & Contextual Barriers Silos mentality Hierarchical layers, Rigid policies, unclear channels and outdated technology Self Learning Topics Corporate Communication Workplace & Outer Agencies Internal communications: Regular email updates company-wide newsletters and bulletin boards External Communication: Brand messaging, crisis communication, and stakeholder engagement.	5 5	CO1
II	Active Listening	Active Listening: Discussions, and note-taking techniques. Audio-book listening, Understanding colleagues' and clients during meetings Types of Listening Detailed Oriented Listening , Overview Listening and Reflective Listening Self-Learning Topics Listening kryptonite in Corporate Settings Technology overload (hello,	2	CO2

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

		constant notifications), Information overwhelm Multitasking Distraction, Tunnel Vision, Neglecting Nonverbal Cues, Technical vs. Human Disconnect Poor Documentation & Follow-Up, Interrupting & Rushing	2	
III	Conversational Proficiencies	Technical Communication Skills: Technical Discussion, delivering technical oral presentations inside and outside organizations, Explaining Engineering Concepts in Simple Terms, (Tips & Guidelines) Grooming and Self Development: Articulatory Speech Sounds ,Acoustic Speech Sounds ,Pronunciation of Accent Neutralization: Useful for professionals interacting with international clients, Virtual Meetings & online Discussion, Problem-Solving , Poster Presentation and Q&A Self-Learning Topics: Technical Terms: Ensuring correct articulation of IT jargon like "cache," "router," or "SQL.", Field Specific terms Record your own speaking imitating native accent and pronunciation and fluency, Engage in discussion with colleagues and tech groups to adopt an impressive & open communication style.	2 2	CO3

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified | DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

IV	Text Interpretation Expertise	Reading Proficiency Intensive Reading, Extensive Reading Skimming, Scanning, SQ5R Method (Survey, Question, Reading, Recording, Recall, Review and Revise) Industry Related Articles and Report, .Summarizing text to Graphic Organizers (GO) Infographics ,Flow Charts , Mind Maps, SWOT analysis Gantt Charts, Venn Diagram Different Types of Organograms etc. Summarising text in point form. Leveraging Online Resources: Courses like IEEE English for Technical Professionals: White Papers; Modifiers and Qualifiers Self-Learning Grammar and Vocabulary Practice Verbal Ability Test (GRE , TOEFL, IELTS) Technical articles and reports and Technical Blogs	2	
V	Technical & Corporate Writing Skills	Seven Cs of Business Writing Completeness, Conciseness, Consideration, Concreteness, Clarity, Courtesy, Correctness. Format & Types of Formal Letters :Inquiry Letter Cover Letter, Offer Acceptance / Rejection Letter Grievance Letter Thank you Letter, Technical Writing for Professionals: Short And Long Reports Formatting Guidelines Tips For Text Chat Software Installation Guides Standard Operating Procedures (SOP) press Releases Legal and compliance writing: Data Privacy Policy , Compliance Reports and License Agreement	3	

9 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E. Information Technology

		Self Learning Studio activities : Digital Content Creation for Social Media and e-Commerce Platforms, Short videos, Blogs, Vlog Keynote speeches Podcast titles Landing pages Social media posts YouTube video description	3	
VI	Community Communication and Ethics	Communicating clearly with non-technical users and stakeholders, Building supportive networks Promoting innovation and problem-solving Participating in user groups or tech meetups. Gain encouragement and advice on technical or career challenges from Tech folk group Sustainability and Green IT Communication. Awareness of modern technology tools Transparency and Honesty Accountability Avoiding Misuse of Information Uphold ethical standards in all written, verbal, and digital communication. Self Learning Ethical use of technology, Sustainable Study Habits: Time Management and Responsibility. Linking with Tech folk (Ethical Hackers, Makers , founders)	1 1	
	Total		30	

References:

1. Communication Skills by Sanjay Kumar & Pushp Lata

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick & Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online References:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/
4.	https://venngage.com/blog/white-paper-examples/

IAT -I 20 marks

IAT-II 20

Marks

IAT -I - Independent speaking activity, where a student will deliver a three mins. prepared speech on a Technical topic related to his program and a two mins. Impromptu speech on general topics.

IAT -II - Group speaking activity, Effective presentations on well-known company case studies, Industry reports and articles. Group members limit, 4-5 students in each group.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98422213	Corporate Communication LAB	-	-	2	-		30		30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Exam	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT2	Total				
98422213	Corporate Communication LAB	--	--	--	--	25	-	25

Lab Objectives: The learners should be able to:

1. Effectively explore the dynamics of digital communication in academic and professional arenas.
2. Positively acquire active listening skills through Speech Acts in different modes.



R-2025- F.E - Information Technology

3. Thoroughly analyse communication barriers, audience and purpose to speak effectively at the workplace.
4. Minutely demonstrate technical and non-technical text to comprehend and discern the exact purposes
5. Efficiently organize and create purposeful technical and business writings using ICT enabled media.
6. Successfully manage teams and individual tasks by applying ethical standards to execute the tasks.

Lab Outcomes: The learners will be able to:

1. Apply computer mediated communication principles for excellence in professional settings.
2. Test listening capabilities for advanced listening strategies using physical and digital modes.
3. Evaluate and present technical and non -technical ideas precisely to the audience in a confident way.
4. Demonstrate reading proficiencies through practicing extensive technical and business texts for developing new ideas.
5. Design digital, technical and business content for professional transactions.
6. Implement interpersonal skills and professional ethics to provide fair and collaborative community solutions using modern technical tools

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic knowledge of English language and ICT enabled media		
I	Communication Dynamics	Application of Communication Dynamics .Key Components of Strategic Communication,Shannon-Weaver Model at workplace. Corporate Communication in Select Indian Companies; A Case Study ,News Letter, Brand messaging	4	LO1



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

II	Active Listening	Detailed Oriented Listening and Applications: Technical or Business podcasts, Youtube lecture on academic stuff/ processes/ procedures/ Development Plans Overview Listening and Applications: Listen to an audio recording presentation, podcast Interviews and summarise in your words in an oral manner Reflective Listening: In daily conversation scenarios draw inferences from the speaker's statements. Discover the ability to understand the speaker's implied meaning rather than literal meaning. (5-10) situational statements in Professional Setting must be done)	4	LO2
III	Conversational Proficiencies	Conversational Activities -I Self Introduction, Prepared Speech on Technical Topics and Impromptu Speech on General Topics Conversational Activities-II Simulation in communication : Role Play Activity for Conflict Resolution Negotiation , Handling complaints or angry customers through simulated phone or chat interactions. Conversational Activities -III customer Communication, Cross-Cultural communication, Marketing & Brand Communication Handling Q&A in Presentation	8	LO3



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

IV	Text Interpretation Expertise	Practice Verbal Ability Test (GRE TOEFL and IELTS for grammar and vocabulary Prepare Diagram Organizers on: Summarising text to Graphic Organisers (GO) Infographics ,Flow Charts , Mind Maps, SWOT analysis Gantt Charts, Venn Diagram Different Types of Organograms etc. as per the situations in the organizational setting. Summarising text in point form after reading white paper , Industry reports and articles	4	LO4
V	Technical and Corporate Writing	Technical content: Technical Blog Short And Long Reports (PPT using Canva) Installation Guides Writing Letters and eMails ,Inquiry Letter Cover Letter, Offer acceptance / Rejection Letter Grievance Letter Thank you Letter Standard Operating Procedures (SOP) Data Privacy Policy , Compliance Reports and License Agreement Press Release Content Creation for Social Media Content Management System - Wordpress to create, manage and publish content. e-Commerce Platforms Studio Activity: Blogs, Vlog Keynote speeches Podcast titles, Landing pages Social media posts (Ensure minimum 3 of these categories are to be covered as experiment)	6	LO5
	Community	Local Area Visit (Nearby Banks ,Hospitals, stores, School , colleges Field		



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

VI	Communication and Ethics	Visits .Surveys ((Face to face, Kiosk /Mobile , QR Code/ SMS) & Feedback Analysis and Report Writing ,Providing solutions for Technical issues	4	LO6

Reference Books:

- 1.Communication Skills by Sanjay Kumar & Pushp Lata
2. Business Communication with Writing Improvement Exercises. Hemphill, McCormick & Hemphill
3. Business Communication: Building Critical Skills by Locker, Kitty O. Kaczmarek, Stephen Kyo
4. Effective Business Communication by Herta Murphy
5. Technical Communication: Principles and Practice by Raman and Sharma
6. Effective Technical Communication: A Guide for Scientists and Engineers by Rizvi
7. Oxford Guide to Effective Writing & Speaking by John Seely
8. English Grammar by Raymond Murphy
9. Word Power Made Easy by Norman Lewis

Online Resources:

Sr. No.	Website Name
1.	https://bbclearningenglish.org
2.	https://www.bbc.co.uk/learningenglish
3.	https://www.anmconsultants.com/role-communication-indian-corporate-culture/



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

List of Experiments.

Sr. No	Name of Experiment	Hours
1.	Prepare a case study on Corporate level Communication in Select Indian Companies Tata Consultancy Services (TCS), Infosys, Reliance Industries, HCL Technologies, Wipro etc.	02
2	Listening Skill Activity Sheet containing minimum three types of listening activities from Lab Syllabus. (Using Language Lab & Open Source)	02
3	A. Continuous Evaluation of at least three types of the activities from Lab Syllabus for proficiency in oral communication/presentation	02
4.	a. Two Verbal Ability Test based on GRE, TOEFL, IELTS b. Summary report and Graphic Organizers for the relevant scenario or situation c. Powerpoint / Slide Preparation on Corporate Cases studies available online	02
5.	Three Types of Letter Writing in prescribed format (Full Block) along with impressive email messaging Digital Content Creation from Lab syllabus (Minimum two activities for writing skills should be done with documentation).	02
6.	Conduct field visits to small scale business community, Government and non Government Agencies Providing awareness about e-commerce platforms for startup and small stores. Also ensure the implementation of technical subject completely or partially for the smooth functioning. Conduct a Survey(Face to face, Kiosk /Mobile , QR Code/ SMS) or get a feedback from outside agencies regarding the future inputs for synergistic solutions	02



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- F.E - Information Technology

Term Work - 25

Experiments/Practicals

10 experiments from all six modules will be conducted using a language lab , open source and must be documented well for final submission as a part of term work at term end.

20 marks

Attendance -5 Marks

R-2025- F.E Information technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
98471214	Audit Course (non-graded)	3	-	-	3	-	-	-

Audit Course: Developing a Research Ecosystem @ SLRTCE

This audit course is specifically designed for students keen on exploring the multifaceted world of research within an engineering context. It offers a unique opportunity to gain a comprehensive understanding of the essential components that drive a vibrant research ecosystem, without the pressure of examinations or academic credit. Students auditing this course are expected to actively participate in class discussions and complete assigned work, thereby enriching their educational experience beyond the confines of their core curriculum.

Course Objectives:

The primary objective of this audit course is to equip students with foundational knowledge and practical insights into key areas crucial for cultivating a strong research culture in engineering colleges. By the end of this course, students will:

- Understand the significance of Intellectual Property Rights (IPR) in academic research.
- Differentiate between various forms of IPR, including Copyright and Patents, and their implications.
- Gain an introductory understanding of the patenting process.
- Learn the fundamental principles of effective research paper writing.
- Develop skills in structuring and writing compelling research proposals.
- Appreciate the ethical considerations and best practices in academic research.

Course Structure:

This course will be delivered in Semester 2 through three weekly lectures, each focusing on a specific aspect of the research ecosystem. The interactive nature of the lectures will encourage active participation, critical thinking, and collaborative learning. To ensure relevance and specialized learning, each department is empowered to customize the course content based on their unique discipline.

S.E Syllabus

SEM 3

Preface:

THEME: Sustainable Computational Solutions for Real-World Societal Challenges Aligned with United Nations Sustainable Development Goals (SDGs)— particularly:

UNSDG 4: Quality Education,

UNSDG 8: Decent Work and Economic Growth,

UNSDG 16: Peace, Justice and Strong Institutions

Keywords: Sustainability, digital literacy, skill development, resource management, accessibility

This theme, "Sustainable Computational Solutions for Real-World Societal Challenges," focuses on the use of computational technologies to address pressing issues in education, employment, environmental sustainability, and public health, particularly in emerging urban and semi-urban regions like Mira Bhayandar. It directly supports several United Nations Sustainable Development Goals (UN SDGs)

UN SDG Alignment:

For Quality Education (SDG 4):

- **Accessible Digital Learning Platforms:**

Providing customized educational content for underprivileged students and those with learning disabilities.

- **Gamified Learning Modules:**

Create engaging educational content for primary and secondary school students.

- **Virtual Labs:**

Develop accessible, low-cost simulation labs for science and computational subjects for students in resource-constrained schools.

For Decent Work and Economic Growth (SDG 8):

- **Digital Skill Development Hubs:**

Platforms for skill assessment, training in emerging technologies and real-time job mapping for local industries.

- **Local Artisan Marketplaces:**

Enable small businesses and artisans to reach broader markets with minimal digital barriers.

- **Real-Time Gig Economy Platforms:**

Connect freelancers and gig workers to nearby digital work opportunities with fair pay and accessibility.

Digital Governance and Transparent Institutions (UNSDG 16)

- Strengthen **transparency, inclusion, and justice** using technology,
- Promote **peaceful societies** through data-driven public safety mechanisms,
- Build **responsive and ethical institutions** with sustainable digital infrastructure.

Local Problem Statements for Mira Road / Mira-Bhayander

- 1. Mira-Bhayandar possesses rich cultural assets, local heritage sites, and traditional crafts that remain largely under-promoted and disconnected from mainstream tourism circuits. This gap not only hampers opportunities for local artisans, guides, and small businesses but also contributes to the gradual erosion of cultural identity. the city misses a vital opportunity to create decent livelihoods and strengthen community pride.**
- 2. The current public complaint mechanisms in Mira-Bhayander are manual, delayed, and lack transparency. There is a need to track, prioritize, and resolve civic issues like garbage collection, water leaks, and road damage in real-time.**
- 3. Street vendors and small-scale hawkers in Mira Bhayandar are unable to fully participate in the cashless economy due to a lack of digital payment adoption and limited understanding of digital marketplaces. This exclusion limits their customer base , economic potential and growth.”**
- 4. Many residents in Mira Bhayandar, especially elderly people and women in lower-income groups, lack timely access to accurate health information in Marathi, Hindi, or Gujarati. Important updates on vaccination camps, public health advisories, and disease outbreaks are either delayed or communicated in complex medical terms. This restricts access to health resources and improve public health outcomes.”**
- 5. Public libraries and community centers in Mira Bhayandar have low attendance and limited digital outreach. These result in underutilization of valuable community resources affects community engagement and promotion of lifelong learning.”**
- 6. Local farmers near Mira Bhayandar struggle to connect directly with urban consumers due to lack of digital platforms that support farm-to-home deliveries. They rely on intermediaries, reducing their profits. This gives rise to irregular delivery scheduling which hampers the promotion of sustainable agriculture and support for local food systems.”**



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025 S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211301	Discrete Mathematics and Graph Theory	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
15211301	Discrete Mathematics and Graph Theory	20	20	40	60	2.5	25	--	125

Rationale:

Elementary Number Theory forms the basis of many cryptographic algorithms used for securing data in IT systems, such as public-key encryption and digital signatures. Functions and Mathematical Relations are fundamental in modeling database relationships, designing algorithms, and structuring software systems. The Fundamental Principle of Counting helps in solving combinatorial problems related to network configurations, password strength calculations, and resource allocation. Algebraic Structures like groups and fields provide the mathematical framework for error correction, hashing, and encryption techniques used in secure communications. Graph Theory is essential for understanding network topologies, optimizing routing protocols, and managing dependencies in software engineering. Finally, Coding Theory equips students with techniques to detect and correct errors in data transmission and storage,



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025 S.E Information Technology

ensuring reliability in IT infrastructures. Together, these topics prepare students to apply rigorous mathematical reasoning to practical IT engineering challenges..

Course Objectives:

1. To understand the basic principles of number theory and their relevance to secure computing.
2. To Explain the properties and types of functions and relations used in system modeling and database design..
3. To describe counting techniques to solve combinatorial problems in IT systems.
4. To understand algebraic systems such as groups, rings, and fields and their use in computing.
5. To understand graph-based models to represent networks and system dependencies.
6. To explain the need for error detection and correction in digital communication.

Course Outcomes:

1. Students will be able to apply concepts such as modular arithmetic and prime factorization in public key cryptography like RSA.
2. Students will be able analyze functional relationships in the design of normalized relational databases and finite state machines.
3. Students will be able to Solve real-world problems like calculating the number of secure passwords or possible network configurations using permutations and combinations.
4. Students will be able to Apply algebraic structures to implement error detection codes and hashing functions in data storage and retrieval systems.
5. Students will be able to use graph algorithms like shortest path or spanning trees in designing optimized communication networks or task scheduling systems.
6. Students will be able to apply coding techniques like Hamming and cyclic codes to ensure reliable data transmission in IT networks and storage systems..

Prerequisite:

1. Definition of sets, Venn diagrams, complements, cartesian products, power sets.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025 S.E Information Technology

2. Propositions and Logical operations, Truth tables, Equivalence, Implications

DETAILED SYLLABUS: Total six module for each subject (15 Weeks)

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Elementary Number Theory	Modular Arithmetic, Divisibility and Euclid Algorithm,	05	CO1
		Primes and Sieve of Eratosthenes.		
		Euler's and Fermat Little Theorem, Congruences, Computing Inverse in Congruences		
		Legendre and Jacobi Symbol, Chinese Remainder Theorem and Well-ordering principle.		
		Self-learning Topics: 1. Wilson's Theorem 2. Applications in modular exponentiation. 3. Quadratic residues 4. Law of Quadratic Reciprocity 5. Continued fractions and Diophantine equations 6. Primitive roots and orders mod n.	08	
II	Functions and Mathematical relations	Types: Injective, Surjective, and Bijective Functions. Composition, Inverse Functions. Real life applications of Functions.	05	CO2
		Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattices, Sub lattice.		
		Self-learning Topics: 1. Practical applications of function in Neural Network. 2. Determining risk factors for insurance rates, Taxes and tax brackets, Vending machines, etc.	07	



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025 S.E Information Technology

		3. Practical applications of relations in real life in the field of Database Management, Economics, Social Network, Sports, Medical Diagnosis, Weather, etc. 4. Equivalence Classes.		
III	Fundamental Principle of Counting	Basic Counting Principle-Sum Rule, Product Rule.	05	CO3
		Inclusion-Exclusion Principle and Pigeonhole Principle		
		Recurrence relations, Solving recurrence relations		
		Self-learning Topics: 1. Applications of Recurrence Relations – Analysis of recursive algorithms in computing. 2. Combinatorial Problem Solving – Using counting techniques in probability and decision-making.	08	
IV	Algebraic Structures	Algebraic structures with one binary operation: Semi group, Monoid,	05	CO4
		Groups and Subgroups.		
		Abelian Group, and Cyclic group.		
		Self-learning Topics: 1. Algebraic structures with two binary operations: Ring. 2. Integral domain 3. Finite fields. 4. Error Correcting codes. 5. Isomorphism of groups and rings.	08	
V	Graph Theory	Types of graphs, Graph Representation, Sub graphs.	05	CO5
		Operations on Graphs, Walk, Path, Circuit, Connected Graphs, Disconnected Graph, Components of Graph.		
		Homomorphism and Isomorphism of Graphs.		



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025 S.E Information Technology

		Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex.		
		Trees and application of trees.		
		Self-learning Topics: 1. Network Flow Problems – Understanding flow in networks and its optimization. 2. Graph Coloring Applications in Scheduling – Use of graph coloring in timetabling and resource allocation. 3. Optimization Techniques – Application of graphs in shortest path problems, spanning trees, and clustering. 4. Spanning trees.	07	
VI	Coding Theory	Introduction to coding	05	CO6
		Group Codes, Decoding and Error Correction		
		Maximum Likelihood Decoding Technique		
		Self-learning Topics: 1. Cyclic and Polynomial Codes 2. Linear Block Codes 3. BCH and Reed–Solomon Codes	07	

Text Books:

1. Susanna S. Epp, “Discrete Mathematics with Applications”, 5th Edition, Cengage Publications.
2. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, 5th Edition, Pearson Publications.
3. Edgar Goodaire and Michael Parmenter, “Discrete Mathematics and Graph Theory”, 3rd Edition, Pearson Publications.

Reference Books:

1. Kenneth A. Ross, “Discrete Mathematics”, 5th Edition, Pearson Publications.

R-2025 S.E Information Technology

2. Swapan Kumar Sarkar, "Textbook of Discrete Mathematics", 9th Edition, S. Chand Publications.
3. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", 6th Edition, Pearson Education.
4. T. Veera Rajan, "Discrete mathematics with Graph Theory and Combinatorics", McGraw Hill Publications.
5. C. L. Liu "Elements of Discrete Mathematics", second edition 1985, McGraw-Hill Book Company.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106094
2.	https://nptel.ac.in/courses/106108227
3.	https://nptel.ac.in/courses/106106183
4.	https://nptel.ac.in/courses/106103205
5.	https://nptel.ac.in/courses/111107058
6.	https://nptel.ac.in/courses/106103015

Assessment:

Term work (TW) for 25 marks:

General Instructions:

R-2025 S.E Information Technology

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write **at least 10** class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project.

This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks.
2. Class Tutorials on entire syllabus 10 marks.
3. Mini Project 10 marks.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211302	Advance Data structure and Algorithm	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211302	Advance Data structure and Algorithm	20	20	40	60	2.5	--		100

Rationale :

Advanced Data Structures and Algorithms (ADSA) are crucial in engineering as they enable efficient data organization, retrieval, and problem-solving using optimized computational techniques. Mastering ADSA helps students design high-performance software solutions and

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- S.E Information Technology

forms the basis for advanced fields like artificial intelligence, data science, and system design.

Course Objectives:

- 1 To understand the mathematical foundations essential for algorithm analysis.
- 2 To explore and study advanced data structures.
- 3 To apply the greedy strategy for problem-solving.
- 4 To gain knowledge of backtracking techniques and maximum flow in networks.
- 5 To learn and implement dynamic programming approaches.
- 6 To comprehend the fundamentals of pattern matching.

Course Outcomes:

On successful completion, of course, learner/student will be able to:

1. Learn techniques to analyze algorithms and solve recurrence relations. (L2, L4)
2. Identify and apply suitable advanced data structures for specific problems, along with analyzing their time and space complexities. (L3, L4)
3. Examine the greedy approach for problem-solving and assess its effectiveness. (L4, L5)
4. Explore and assess backtracking algorithms and gain insight into solving problems involving maximum flow in networks. (L2, L5)
5. Apply dynamic programming strategies to efficiently solve complex problems. (L3)
6. Choose and implement the most appropriate pattern matching algorithm based on the problem context. (L5, L3)

Prerequisite: Overview of Data Structures: Revision of basic data structures (arrays, stacks, queues, linked lists, trees).



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Overview of Data Structures: Revision of basic data structures (arrays, stacks, queues, linked lists, trees).	1	
I	Introduction to Analysis of Algorithms	Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic notation, Recurrence Relations: Methods to solve recurrence relations in algorithms (Substitution, Recursion tree, Master theorem).	4	CO1
		Self-learning Topics: Solve problems on analysis of algorithms.	5	
II	Advanced Data Structures	Introduction. AVL trees, B tree, B tree operations, B+ tree, Red-Black Trees, tries data structures, time complexity analysis of all problems. Graphs, Representation, Graph Traversals: Breadth First Search, Depth First Search.	9	CO2
		Self-learning Topics: Solve problems on AVL trees, B tree, B+ tree etc.	6	
III	Greedy algorithms and Applications	Introduction and properties of greedy algorithms, Fractional Knapsack problem, Minimum Spanning Trees (Prim's and Kruskal's algorithms), Job	7	CO3

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		sequencing with deadlines, Optimal storage on tapes, Analysis of All problems.		
		Self-learning Topics: Solve problems on Spanning Trees, Knapsack etc.	9	
IV	Backtracking and Maximum flow Networks	Backtracking Techniques: Introduction, N-Queens problem, sum of subsets problem, graph coloring, Hamiltonian cycles. Introduction to flow networks, Augmenting Paths Residual Network, Ford Fulkerson method, Applications of Flow Networks in real-world problems.	9	CO4
		Self-learning Topics: Solve problems N-Queens, Hamiltonian cycles, Augmenting Paths Residual Network etc.	7	
V	Dynamic Algorithms	Introduction Dynamic algorithms, Greedy vs. Dynamic algorithms, Single source shortest path- Dijkstra's Algorithm, Bellman Ford Algorithm, All pair shortest path- Floyd Warshall Algorithm, 0/1 knapsack problem, Travelling salesman problem, Analysis of All problems.	10	CO5
		Self-learning Topics: Solve problems on shortest path- Dijkstra's Algorithm etc. Solve problems on DNA	7	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		equencing, and data compression.		
VI	String Matching Algorithms and Application on Advance Data Structure & Analysis	Introduction String Matching Algorithms, Naïve string matching algorithm, Rabin-Karp algorithm, Knuth-Morris-Pratt(KMP) algorithm, Longest common subsequence(LCS).	05	CO6
		Self-learning Topics: Case Study 1: Optimizing Water Distribution using Graph Algorithms and Network Flow Analysis. Case Study 2: Waste Management Route Optimization using Greedy and Dynamic Programming Approaches Case Study 3: Real-Time Disaster Relief Logistics using Advanced Priority Queues and Backtracking. Case Study 4: Efficient Digital Land Record Management using B+ Trees Case Study 5: Green Library Management System for Smart Campuses Case Study 6: Dynamic Algorithms in Disaster Response and Relief Management	11	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Text Books

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, PHI 3rd Edition, 2011
2. Algorithm Design, Jon Kleinberg, Éva Tardos, Pearson, 1st Edition 2006
3. Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss
4. Data Structures, Algorithms and Applications in C++ by Sartaj Sahni

References:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, 3rd Edition, 2011
2. Algorithms Robert, Sedgewick, Kevin Wayne, Addison- Wesley, 4th Edition 2011

Online Resources:

S. No.	Website Name	URL
1	NPTEL	https://archive.nptel.ac.in/courses/106/106/106106200/
2	NPTEL	https://archive.nptel.ac.in/courses/106/105/106105085/
3	NPTEL	https://archive.nptel.ac.in/courses/106/104/106104120/
4	Coursera	https://www.coursera.org/learn/algorithms-part1
5	MIT OpenCourseWare	https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R- 2025 S.E – Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211303	Database Management System & Application	3		--	45		--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211303	Database Management System & Application	20	20	40	60	2.5	--	--	100

Rational:

Database Management Systems (DBMS) play a crucial role in engineering by teaching students how to efficiently store, retrieve, and manage large volumes of data. They provide foundational knowledge essential for building reliable and scalable software systems across



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R- 2025 S.E – Information Technology

various domains.

Course Objectives

1. To learn the basics and understand the need for database management systems and To Build a Relational Model from ER/EER.
2. To construct a conceptual data model and Relational algebra.
3. To introduce the concept of SQL to store and retrieve data efficiently.
4. To demonstrate notions of normalization for database design.
5. Understand the concepts of transaction processing- concurrency control and recovery procedures.
6. To understand Advance DBMS and the applications of concepts learnt in this subject.

Course Outcomes:

1. Identify the need of a Database Management System. (L1, L2)
2. Design conceptual model for real life applications. (L6)
3. Formulate query using SQL commands. (L3)
4. Apply the concept of normalization to relational database design.(L3)
5. Demonstrate the concept of transaction, concurrency and recovery.(L2)
6. Apply the concept of DBMS, ADBMS and SQL to solve the case study.(L3)

Prerequisite: C, Python Programming.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	C, Python Programming.	02	--
I	Database System Concepts, Architecture, and ER Models.	Introduction, Characteristics of Databases, File system v/s Database system, Data abstraction and Data Independence, DBMS system architecture, Database Administrator (DBA), Role of DBA. Conceptual Modeling of a database, The Entity-Relationship (ER) Model, Entity Type, Entity Sets, Attributes and Keys, Relationship Types, Relationship Sets, Weak entity Types. Generalization, Specialization and Aggregation, Extended Entity-Relationship (EER) Model.	08	CO1



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R- 2025 S.E – Information Technology

		Self-learning Topics: Identify the types of Databases. Design a ER diagram based on any of the application such as banking system, Healthcare System etc.	07	
II	Relational Model & Relational Algebra	Introduction to Relational Model, Relational Model Constraints and Relational Database Schemas, Concept of Keys: Primary Key, Secondary key, Foreign Key, Mapping the ER and EER Model to the Relational Model, Introduction to Relational Algebra, Relational Algebra expressions for Unary Relational Operations : Set Theory Operations, Binary Relational Operations.	07	CO2
		Self-learning Topics: Map the ER model designed in module I to relational schema. Explore tools that are used to represent relational algebra. Practice relational algebra queries using real life rural datasets, Compare join operations using examples.	08	
III	Structured Query Language (SQL)	Overview of SQL, Data Definition Commands, Set Operations, Aggregate Function, null values, Data Manipulation commands, Data Control commands, Complex Retrieval Queries using Group By, Recursive Queries, nested Queries, Integrity constraints in SQL. Database Programming with JDBC, Security and authorization: Grant & Revoke in SQL Functions and Procedures in SQL and cursors. Indexing: Basic Concepts, Ordered Indices, Index Definition in SQL.	06	CO3
		Self-learning Topics: Physical design of database for the relational model designed in module III and fire various queries. Practice and perform all the queries of DDL and DML in a rural dataset.	08	



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R- 2025 S.E – Information Technology

IV	Relational Database Design:	Design guidelines for relational Schema, Functional Dependencies, Database tables and normalization, The need for normalization, The normalization process, Improving the design, Definition of Normal Forms- 1NF, 2NF, 3NF & The Boyce-Codd Normal Form (BCNF).	07	CO4
		Self-learning Topics: Design a database and perform normalization, compare all the normal forms based on database you've created.	08	
V	Transaction	Transaction: Transaction concept, State Diagram, ACID Properties, Transaction Control Commands, Concurrent Executions, Serializability – Conflict and View, Concurrency Control: Lock-based-protocols, Deadlock handling Timestamp-based protocols, Recovery System: Recovery Concepts, Log based recovery.	07	CO5
		Self-learning Topics: Study the various deadlock situations which may occur for a database designed in module V.	07	
VI	Advanced DBMS Applications & Real World Problem Solving	Introduction to bigdata and hadoop ecosystem, Role of datasets in AI/ML integration, NoSQL databases overview. Advanced bigdata tools and trends. Bigdata Security and privacy. Limitations of traditional RDBMS for big data.	08	CO6
		Self-learning Topics: Case study : 1) To design a scalable data management solution using traditional DBMS and bigdata technologies to store, process and analyze healthcare records . 2) To design and implement a database system that captures and analyzes key indicators of	07	



R- 2025 S.E – Information Technology

		education quality across schools/colleges such as teacher-student ratio, infrastructure, learning outcome, and dropout rates to support evidence based educational policy and planning.	

Text Books:

1. Korth, Slberchatz, Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2. Elmasri and Navathe, Fundamentals of Database Systems, 6th Edition, Pearson education
3. Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH

References:

1. Peter Rob and Carlos Coronel, — Database Systems Design, Implementation and Management, Thomson Learning, 9th Edition.
2. SQL & PL / SQL for Oracle 11g Black Book, Dreamtech Press
3. G. K. Gupta : “Database Management Systems”, McGraw – Hill

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://www.oreilly.com
3.	https://www.coursera.org/



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211304	Automata Theory	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211304	Automata Theory	20	20	40	60	2.5	--	--	100

Rationale : " It provides a foundational understanding of computation and equips students with the tools to design efficient systems, validate software, and solve complex engineering problems."

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Objectives:

1. To understand the relation between Regular Language and Finite Automata and machines.
2. To learn fundamentals of Regular and Context Free Grammars and Languages.
3. To learn how to design Automata's as Acceptors, Verifiers and Translators.
4. To understand the relation between Regular Languages, Contexts free Languages, PDA and TM.
5. To learn how to design PDA as acceptor and TM as Calculators.
6. To learn applications of Automata Theory.

Course Outcomes:

1. Design different types of Finite Automata and Machines as Acceptor, Verifier and Translator. (L6)
2. Explain, analyze and design Regular languages, Expression and Grammars. (L2, L4, L6)
3. Analyze and design Context Free languages and Grammars. (L4, L6)
4. Design different types of Push down Automata as Simple Parser.(L6)
5. Design different types of Turing Machines as Acceptor, Verifier, Translator and Basic computing machine. (L6)
6. Develop understanding of applications of various Automata. (L6)

Prerequisite:

Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Mathematical Fundamentals: Sets, Logic, Relations, Functions.	02	
I	Basic Concepts and Finite Automata	Languages: Alphabets and Strings. Closure properties, Finite Automata (FA) and Finite State machine (FSM). Finite Automata as a language acceptor or verifier Finite Automata - Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA) : Definitions, transition diagrams and Language recognizers, NFA (with and without ϵ), DFA, RE to NFA, NFA to DFA Conversion , Reduced DFA , NFA-DFA equivalence, FA to RE. Finite State Machines with output : Moore and Mealy machines. Applications and limitations of FA.	10	CO1
		Self-learning Topics: Practice exercise on FA and NFA	09	
II	Introduction and Regular Languages	Regular Languages: Regular Expressions, Regular Languages, Regular Grammars, RL and LL grammars, Closure properties , Arden's Theorem	07	CO2

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Self-learning Topics: Practice exercise on Regular Expressions. Identify the tools also.	06	
III	Context Free Grammars	Context Free Languages: CFG, Leftmost and Rightmost derivations, Ambiguity, Simplification of Context Free Grammar, Chomsky Normal Form ,Greibach Normal Form (CNF & GNF) and Chomsky Hierarchy (Types 0 to 3)	09	CO3
		Self-learning Topics: Practice numerical or exercise on CFG	09	
IV	Push Down Automata	Push Down Automata: Deterministic (single stack) PDA, Equivalence between PDA and CFG. Power and Limitations of PDA.	07	CO4
		Self-learning Topics: List the examples of PDA.	06	
V	Turing Machine	Turing Machine: Deterministic TM, Variants of TM, Halting problem, Power of TM.	06	CO5
		Self-learning Topics: Practice numerical of TM.	07	
VI	Applications of Automata	Applications of FA, CFG, PDA & TM. Introduction to Compiler & Its phases.	04	CO2,CO3, CO4,CO5, CO6
		Self-learning Topics: Case study on 1. Automating Skill Development in E-Learning Platforms with Finite Automata (FA) 2.Context-Free Grammar (CFG) for Creating Sustainable Business Models	08	

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		3.Sustainable Water Distribution in Agriculture Using Pushdown Automata (PDA)		
		4. Turing Machines for Simulating Climate Change Models		

Text Books:

1. J.C.Martin, “Introduction to languages and the Theory of Computation”, TMH.
2. Kavi Mahesh, “Theory of Computation A Problem Solving Approach”, Wiley India
3. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman , “Compilers Principles, Techniques and Tools “,Pearson Education.

References:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, “Introduction to Automata Theory, Languages and Computation”, Pearson Education.
2. Daniel I.A. Cohen, “Introduction to Computer Theory”, John Wiley & Sons.
3. Vivek Kulkarni,” Theory of Computation”, Oxford University.
- 4.N.Chandrashekhar, K.L.P. Mishra, “Theory of Computer Science, Automata Languages & Computations”, PHI publications.
5. J. J. Donovan, “ Systems Programming”, TMH.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com

R-2025- S.E Information Technology

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in
2.	https://online.stanford.edu
3.	https://www.coursera.org/

*R-2025- S.E. Information Technology*

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15212305	ADSA Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15212305	ADSA Lab	--	--	--	--	25	25	50

Lab Objectives: The course aims to

1. To analyze and evaluate the mathematical foundations and complexities of various algorithms.
2. To implement and apply diverse advanced data structures to efficiently solve complex computational problems.
3. To design and develop solutions utilizing greedy algorithms, assessing their applicability and limitations.
4. To construct and optimize solutions using backtracking algorithms and model problems with maximum flow networks.
5. To formulate and implement solutions using dynamic programming techniques, evaluating their performance trade-offs.



6. To select and integrate appropriate pattern matching algorithms for efficient string and sequence analysis in real-world applications.

Lab Outcomes: Upon completion of the course students will be able to:

1. Calculate and interpret the space and time complexities of algorithms, justifying their efficiency for various problem sizes.(L3, L4, L5)
2. Implement and critique advanced data structures such as balanced trees, heaps, and hash tables to optimize data storage and retrieval.(L3, L4, L5)
3. Apply greedy programming techniques to solve optimization problems, evaluating the optimality and feasibility of their solutions.(L3, L5)
4. Develop backtracking algorithms to explore solution spaces for combinatorial problems and model network flow problems using relevant algorithms. (L3, L6)
5. Design and construct dynamic programming solutions for complex problems, comparing their performance with other algorithmic paradigms. (L6, L5)
6. Choose and adapt appropriate string matching algorithms for text processing and bioinformatics applications, justifying their selection based on performance requirements. (L3, L5)

Software Requirement: C/C++/Java

List of Experiments.

Sr No	List of Experiments	Hrs
01	Implement and compare the performance of Merge Sort and Quick Sort for large datasets, analyzing their space and time complexities.	1
02	Design and implement a randomized quicksort algorithm, evaluating its average-case performance.	1
03	Explore and implement various hash functions and collision resolution techniques (e.g., separate chaining, open addressing), assessing their efficiency.	1

*R-2025- S.E. Information Technology*

04	Construct and traverse Binary Search Trees (BSTs) for given data sequences. Analyze and visualize the tree structure and traversal complexities.	2
05	Implement robust insert, delete, search, and display operations on BSTs, handling edge cases and evaluating their complexities.	2
06	Develop and demonstrate operations (insert, delete, search) on B-Trees or B+-Trees, discussing their applications in databases.	2
07	Implement and evaluate the performance of AVL or Red-Black trees to maintain balanced search trees.	1
08	8. Implement a solution for the fractional knapsack problem using a greedy approach and compare it with the 0-1 knapsack problem (dynamic programming).	1
09	Implement Prim's and Kruskal's algorithms to find Minimum Spanning Trees (MSTs) and visualize the construction process.	2
10	Develop a solution for the job sequencing with deadlines problem, optimizing total profit.	1
11	Implement the N-Queens problem using backtracking, visualizing the solution space exploration.	2
12	Develop a solution for the Sum of Subsets problem using backtracking, identifying all possible subsets that sum to a target.	2
13	Implement Hamiltonian cycles for a given graph, determining if a cycle exists that visits each vertex exactly once.	2
14	Implement the Bellman-Ford algorithm to find shortest paths in graphs with negative edge weights, handling negative cycles.	2
15	Implement the Floyd Warshall Algorithm to compute all-pairs shortest paths in a graph.	2

*R-2025- S.E. Information Technology*

16	Develop a dynamic programming solution for the Traveling Salesperson Problem (TSP) for small instances, analyzing its complexity.	2
17	Implement and compare the Naïve string matching algorithm with the Rabin-Karp algorithm.	2
18	Implement the Knuth-Morris-Pratt (KMP) algorithm for efficient string matching.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Performance Analysis and Optimization Challenge	1
02	Real-world Application of Advanced Data Structures	1
03	Ethical Considerations in Algorithmic Design	1
04	Greedy vs. Dynamic Programming: A Comparative Study	1
05	Network Flow Applications and Optimization	1
06	Algorithmic Efficiency for Sustainable Development	1

Text Books

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, PHI, 3rd Edition, 2011
2. Algorithm Design, Jon Kleinberg, Éva Tardos, Pearson 1st Edition, 2006
3. Data Structures and Algorithm Analysis in C++ Mark Allen Weiss, Pearson 4th Edition, 2013

References:

1. Introduction to the Design and Analysis of Algorithms, Anany Levitin, Pearson, 3rd Edition, 2011



2. Introduction to Algorithms, Robert Sedgewick, Kevin Wayne, Addison- Wesley, 4th Edition, 2011
3. The Algorithm Design Manual, Steven S. Skiena,

Online Resources:

Sr. No.	Website Name
1	NPTEL : https://archive.nptel.ac.in/courses/106/106/106106200/
2	NPTEL : https://archive.nptel.ac.in/courses/106/105/106105085/
3	NPTEL : https://archive.nptel.ac.in/courses/106/104/106104120/
4	Coursera : https://www.coursera.org/learn/algorithms-part1
5	OpenCourseWare : https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15212306	SQL Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15212306	SQL Lab	--	--	--	--	25	25	50

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Rational:

The SQL Lab in engineering education provides hands-on experience in querying, managing, and manipulating data using structured query language. It reinforces theoretical DBMS concepts by allowing students to design schemas, write queries, and implement real-time database solutions.

Lab Objectives:

1. 2 .To construct a conceptual data model for real life applications.
3. To Build a Relational Model from ER/EER and demonstrate usage of relational algebra.
4. To Apply SQL to store and retrieve data efficiently.
5. To implement database connectivity using JDBC.
6. To understand the concepts of transaction processing- concurrency control also learn basics of No-SQL and hadoop functionalities.

Lab Outcomes:

1. Define problem statements and Construct the conceptual model for real life application. (L1, L2, L3)
2. Create and populate a RDBMS using SQL.(L1, L6)
3. Formulate and write SQL queries for efficient information retrieval.(L1, L6)
4. Apply view, triggers and procedures to demonstrate specific event handling.(L2, L3)
5. Demonstrate database connectivity using JDBC.(L2)
6. Demonstrate the concept of concurrent transactions and basics of NoSQL.(L2)

**List of Experiments.**

Sr No	List of Experiments	Hrs
01	Experiment1: Title: Database and Table Creation Aim: Understand how to create a database, tables, and define constraints.	02
02	Experiment2: Title: Basic Data Insertion and Viewing Aim: Insert records into tables and view them.	02
03	Experiment3: Title: Filtering and Conditional Retrieval. Aim: Use filtering conditions to retrieve specific data.	02
04	Experiment4: Title: Data Update and Deletion Aim: Modify and remove records in the database.	02
05	Experiment5: Title: Built-in Functions and Expressions Aim: Use SQL functions for calculations and data manipulation.	02
06	Experiment6: Title: Data Grouping and Aggregation Aim: Analyze data by grouping it.	02
07	Experiment7: Title: Joins – Combining Tables Aim: Retrieve data from multiple related tables.	02
08	Experiment8: Title: Types of joins. Aim: Performing different joining over data sets.	02
09	Experiment9: Title: Views and Indexes Aim: Understand abstraction and performance tuning.	02
10	Experiment10: Title: Nested Queries and Subqueries Aim: To Understand and execute nested queries and subqueries in SQL to retrieve data based on complex conditions using inner SELECT statements.	02



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

11	Experiment11: Title: Set Operators Aim: To use UNION, INTERSECTION and EXCEPT to combine results etc.	02
12	Experiment12: Title: Transactions and TCL Aim: Work with transaction control and consistency.	02
13	Experiment13: Title: Introduction to NoSQL Aim: NoSQL databases overview(Document, Column, Key-Value stores).	02
14	Experiment14: Title : Capstone Project using bigdata and hadoop concepts Aim: Design and implement a small relational schema for a real-world application that can be used to improve quality education in our society (make it more interactive with the help of AIML and big data concept).	02
15	Experiment 15 : Mini Project	02

Sr No	List of Assignments / Tutorials	Hrs
01	Student Information System Create, insert, update, and delete student records.	02
02	Employee Salary Report Generate salary-based summaries using aggregation and filtering.	02
03	Product Inventory Management Implement inventory tables and manage stock using joins and updates.	02
04	Library Database Use joins to fetch book-author details, and subqueries to filter books.	02
05	Sales Dashboard View Create views for monthly sales and apply indexes on region or category.	02
06	Course Enrollment System Manage enrollments with foreign key relations and advanced queries.	02



Text Books:

1. Scott M L, Programming Language Pragmatics, 3rd Edn., Morgan Kaufmann Publishers, 2009
2. Harold Abelson and Gerald Jay Sussman with Julie Sussman foreword by Alan J. Perlis, Structure and Interpretation of Computer Programs (2nd Edition)
3. Graham Hutton, Programming in Haskell, 2nd Edition, Cambridge University Press, 2016

References:

1. Sethi R, Programming Languages Concepts and Constructs , 2nd Ed, Pearson Education
2. Yogesh Sajjanikar, Haskell Cookbook, Packt Publishing, 2017

Online Resources:

Sr. No.	Website Name
1.	FreeCodeCamp – Free hands-on courses with certification.
2.	W3Schools – Comprehensive tutorials with live editors for HTML, CSS, JS.
3.	JSON.org – Official page with structure and use-cases.
4.	XML Validation Tool – Online tool for validating XML and DTD/XSD.

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical& Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.EInformation Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
9951137WW	Open Elective	2	-	-	2	-	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total .					
9951137WW	Open Elective	--	--	--	--	--	25	--	25

Students must select a course for Open Elective from a bucket provided by the Rahul Education Group.

Term Work Assesment: 25 Marks (Total marks) = 15 Marks (Case Study/Activity) + 5 Marks (Assignments) + 5 Marks (Attendance)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.EInformation Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C)
		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
98431308	Entrepreneurship Development	2	-	-	30	-	-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98431308	Entrepreneurship Development	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is a crucial skill in the 21st century, fostering innovation, self-employment, and economic development. This course is designed to equip students with practical entrepreneurial competencies such as ideation, business model development, financial planning, legal frameworks, and pitching.

R-2025- S.EInformation Technology

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.
3. Develop comprehensive business plans and financial strategies.
4. Explore legal and funding options for startups in India.
5. Apply marketing, digital tools, and CRM for business growth.
6. Design prototypes and present business pitches to stakeholders.

Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Explain entrepreneurial concepts and analyze types and traits of entrepreneurs.
- 2) Apply ideation techniques and validate business ideas using customer discovery tools.
- 3) Create business plans with financial projections and risk analysis.
- 4) Evaluate funding sources and legal requirements for a startup.
- 5) Implement digital marketing and branding strategies effectively.
- 6) Prepare and deliver compelling business pitches with basic prototyping.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills.		
I	Introduction to Entrepreneurship	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	4	CO1



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 Case Study: Nirma – A middle-class entrepreneur revolutionizing detergents.	4	
II	Business Idea Generation & Validation	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping, Business Model Canvas (BMC), Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	5	CO2
		Self-learning Topics: Lean Canvas, Persona Creation Case Study: Airbnb – Validating the concept with MVP	5	
III	Business Planning & Strategy	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management.	5	CO3
		Self-learning Topics: Financial forecasting using Excel/Google Sheets. Case Study: Zomato – Expansion through mergers & strategic pivots	5	
IV	Funding and Legal Framework	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities.	6	CO4



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Intellectual Property Rights (IPR) & Patents		
		Self-learning Topics: DPIIT recognition process and types of funding Case Study: Paytm – From Wallet to IPO: Funding journey	6	
V	Marketing & Digital Presence	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models.	5	CO5
		Self-learning Topics: Use of Canva, Google Analytics Case Study: Lenskart – Omnichannel e-commerce marketing	5	
VI	Business Pitching & Prototype Development	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch.	5	CO6
		Self-learning Topics: Canva for pitch deck or Successful Start-ups Case Study: Dunzo – MVP to final app evolution	5	

Text Books:

1. "Entrepreneurship Development and Small Business Enterprises" – Poornima M. Charantimath, Pearson, 3rd Edition, 2021.
2. "Innovation and Entrepreneurship" – Peter F. Drucker, Harper Business, Reprint Edition, 2019.
3. "Startup and Entrepreneurship: A Practical Guide" – Rajeev Roy, Oxford

R-2025- S.E Information Technology

University Press, 2022.

4. "Essentials of Entrepreneurship and Small Business Management" – Norman Scarborough, Pearson, 9th Edition, 2021.
5. "The Lean Startup" – Eric Ries, Crown Publishing, 2018.

References:

1. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" – Bill Aulet, MIT Press, 2017.
2. "Zero to One: Notes on Startups, or How to Build the Future" – Peter Thiel, 2014.
3. "The \$100 Startup" – Chris Guillebeau, Crown Business, 2019.
4. "Business Model Generation" – Alexander Osterwalder & Yves Pigneur, Wiley, 2020.
5. "Blue Ocean Strategy" – W. Chan Kim & Renée Mauborgne, Harvard Business Review Press, 2019.

Online References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	MIT OpenCourseWare – Entrepreneurship – https://ocw.mit.edu/courses/sloan-school-of-management/
3.	Coursera – Entrepreneurship Specialization – https://www.coursera.org/specializations/entrepreneurship

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451309	Environmental Science	2	-	-	30	-	-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
98451309	Environmental Science	20	20	40	60	2.5	--	--	100

Rationale

Environmental Science provides a multidisciplinary perspective to understand, analyze, and solve ecological challenges. With growing global concern over climate change, pollution, and sustainable development, it is essential to equip students with the knowledge, skills, and values needed to contribute to sustainable solutions.

Course Objectives:

1. To understand the interrelationship between human activities and the environment.

2. To explore natural ecosystems and biodiversity conservation techniques.
3. To identify causes, effects, and mitigation strategies for various types of environmental pollution.
4. To analyze key environmental policies, laws, and sustainability practices.
5. To develop awareness, ethics, and responsibility towards environmental protection.
6. To promote sustainable development through informed decision-making and community participation.

Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Explain core concepts of environmental science and ecological balance.
- 2) Identify sources and impacts of pollution on ecosystems and human health
- 3) Evaluate biodiversity importance and conservation strategies.
- 4) Analyze climate change, global warming, and their mitigation approaches.
- 5) Interpret government policies and sustainable practices for environment management.
- 6) Propose solutions for environmental issues at local and global levels.

Prerequisite: Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Science Knowledge, General Awareness – About environmental issues, public policies, and civic responsibilities.	1	
I	The Multidisciplinary	Definition, scope and importance. Need for public awareness. Role of information technology in	5	CO1



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

	Nature of Environmental Studies	environment and human health. Human population and the Environment. Population growth, variation among nations. Population Explosion- family welfare program. Environment and human health Women and child welfare.		
		Self-learning Topics: Environmental ethics Case Study: Chipko Movement (India) – Grassroot conservation.	4	
II	Natural Resources	Renewable and non-renewable resources. Natural resources & associated problems: a. Forest resources: b. Water resources: Natural resources & associated problems c. Mineral resources: d. Food resources: e. Energy resources: Role of an c. Mineral resources: d. Food resources: e. Energy resources: Role of an individual in conservation of natural resources: f. Equitable use of resources for sustainable lifestyles.	5	CO2
		Self-learning Topics: Carbon footprint calculators Case Study: Rainwater Harvesting	5	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, Oceans, estuaries). Case study on various ecosystems in India.	5	CO3
		Self-learning Topics: Biodiversity in Indian context Case Study: various ecosystems in India.	5	
IV	Biodiversity and its Conservation	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity : Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	5	CO4
		Self-learning Topics: Indoor pollution sources	4	
V	Environment al Pollution Definition	Causes of Pollution , effects and control measures of: a. Air pollution b. Water pollution c. Soil pollution. Solid waste management: Causes,	5	CO5



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.		
		Self-learning Topics: Greenhouse gases Case study: Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	5	
VI	Social Issues and Environment	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Consumerism and waste products. Environment protection act. Public awareness.	5	CO6
		Self-learning Topics: Environmental audit methods. Case Study: Environmental Ethics.	5	

Text Books:

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021
2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd

R-2025- S.E Information Technology

Edition, PHI Learning, Publication Year: 2016

3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann 1. Springer 2008
4. Sustainable IT: Slimming Down and Greening Up Your IT Infrastructure, David F. Linthicum, IBM Press 2009
5. Environmental Modelling: Finding Solutions to Environmental Problems, David L. Murray, Cambridge University Press 2016
6. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer, and Jonathan W. Chipman, 9th Edition, John Wiley & Sons 2020
7. Business Ethics: Concepts and Cases, Manuel Velasquez, Pearson 2012

References:

1. Environmental Law and Policy in India, Shyam Divan and Armin Rosencranz, 2nd Edition, Oxford University Press 2018.
2. The International Handbook of Environmental Laws, David Freestone and Jonathon L. Rubin, Edward Elgar Publishing 2000.
3. E-Waste Management: Challenges and Opportunities in Developing Countries, Ruediger Kuehr and Ram K. Jain, Springer 2008.
4. The E-Waste Handbook: Managing Electronic Waste, Klaus Hieronymi, Ruediger Kuehr, and Ram K. Jain, Earth 2009.
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press, 1999.

Online References:

Sr. No.	Website Name
1.	Centre for Science and Environment (CSE), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15612310	IDEA LAB -3 (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15612310	IDEA LAB - 3 (Innovation Design Engineering and Apply)	--	--	- -	--	25	25	50

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.



R-2025- S.E Information Technology

5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly



progress.

- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

- 1. Motivating and Inspiring Students**
 - Encourage students to take ownership of their learning and projects.
 - Cultivate a mindset of curiosity, exploration, and social relevance.
 - Foster an environment where students feel empowered to take creative risks.
- 2. Conducting Brainstorming and Ideation Sessions**
 - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.



- Promote collaborative thinking, design exploration, and interdisciplinary integration.
- 3. **Arranging Guest Lectures and Expert Talks**
 - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
 - Facilitate exposure to real-world challenges, current trends, and future opportunities.
- 4. **Ensuring Uniqueness and Originality of Projects**
 - Actively review proposed ideas to ensure **no duplication of solutions** across students.
 - Encourage students to explore novel approaches, technologies, and perspectives.
- 5. **Promoting Discussion and Collaborative Learning**
 - Create platforms for students to present, discuss, and receive peer and mentor feedback.
 - Facilitate idea refinement through regular discussions and group engagement.
- 6. **Aligning Subject Content Beyond Syllabus**
 - Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
 - This ensures relevance, depth, and meaningful interdisciplinary integration.
- 7. **Same Semester Faculty Requirement**
 - Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
- 8. **Monitoring and Documentation**
 - Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
 - Provide ongoing feedback and ensure project alignment with learning outcomes.
- 9. **Coordination with Subject Faculty**
 - Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
 - Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab



R-2025- S.E Information Technology

Aspect	Implementation Strategy
Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.
Mentoring Role	Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.
Capacity Building	Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.
Assessment Contribution	Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.
Recognition Incentives	& Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.

b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.
Independent Evaluation	Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a separate 25 marks allocated for termwork based on subject application.
Evidence Sources	Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.
Outcome Assurance	Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.



Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
 - Logbooks
 - Subject-specific outputs (e.g., simulations, designs)
 - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner

S.E Syllabus

SEM 4

Theme: Sustainable Digital Supply Chains and Smart Logistics

Aligned with United Nations Sustainable Development Goals (SDGs)— particularly:

UNSDG 9 : Industry, Innovation, and Infrastructure

UNSDG 11: Sustainable Cities and Communities,

UNSDG 12: Responsible Consumption and Production,

UNSDG 13: Climate Action

UNSDG 17: Partnerships for the Goals

Keywords: Smart logistics, green transportation, digital supply chain, real-time tracking, sustainable packaging, last-mile delivery, carbon reduction, accessible logistics.

This theme, "Sustainable Digital Supply Chains and Smart Logistics", is a forward-thinking framework to use emerging technologies for optimizing supply chain efficiency, reducing environmental impacts, and fostering resilient urban logistics.

It is highly relevant for rapidly growing urban areas like Mira Bhayandar, where smart city initiatives, increasing consumer demands, and sustainability pressures require the adoption of intelligent, tech-enabled logistics solutions. This theme aligns with key United Nations Sustainable Development Goals (UNSDGs) by promoting responsible consumption, industrial innovation, and climate-conscious operations.

Alignment with UNSDGs:

For Industry, Innovation, and Infrastructure (UNSDG 9):

- **Digitalization of Supply Chains:** Improving transparency and efficiency in supply chain networks.
- **Smart Warehousing:** Optimizing storage and distribution.
- **Predictive Analytics:** Employing data-driven forecasting for demand management, reducing stockouts and overproduction.
- **Green Transport Solutions:** Promoting electric vehicles, drones, and optimized routing to reduce carbon emissions in logistics.

For Sustainable Cities and Communities (UNSDG 11):

- **Last-Mile Delivery Optimization:** Designing sustainable last-mile solutions to reduce urban congestion.
- **Urban Freight Management:** Smart scheduling to minimize traffic disruptions caused by goods transportation.
- **Smart Infrastructure Integration:** Linking supply chain operations with smart city platforms to ensure seamless logistics, especially around growing transit nodes like the Mumbai Metro Line 9.

For Responsible Consumption and Production (UNSDG 12):

- **Sustainable Packaging:** Adoption of biodegradable and minimalistic packaging solutions to reduce waste.
- **Reverse Logistics:** Implementing efficient return and recycling mechanisms to promote circular economy practices.
- **Supplier Collaboration:** Encouraging eco-conscious sourcing and partnerships with sustainable vendors.

For Climate Action (UNSDG 13):

- **Carbon Footprint Reduction:** Leveraging route optimization, energy-efficient transport, and smart warehousing to minimize greenhouse gas emissions.
- **Data-Driven Sustainability:** Using real-time data to monitor emissions and continuously improve eco-efficiency across the supply chain.
- **Decarbonized Logistics:** Shifting towards renewable energy-powered logistics operations.

For Partnerships for the Goals (UNSDG 17):

- **Public-Private Collaboration:** Engaging local authorities, businesses, and technology providers to co-create smart logistics solutions.
- **Global-Local Supply Chain Partnerships:** Building inclusive supply networks that benefit local businesses while meeting international standards.
- **Community-Centric Logistics:** Developing partnerships with local transport services, SMEs, and digital platforms to foster inclusive growth.

Local Problem Statements for Mira Road / Mira-Bhayander

- 1. In Mira Bhayandar's logistics landscape, there is often limited collaboration between suppliers, transporters, retailers, and local authorities, leading to fragmented operations, duplicated trips, and inefficient resource utilization. The absence of shared logistics platforms and cooperative delivery models results in increased congestion, higher emissions, and reduced profitability. There is a critical need to create more efficient, sustainable, and resilient supply chains.**
- 2. In high-density residential complexes like the increasing number of e-commerce deliveries has resulted in a noticeable surge in packaging waste, especially single-use plastics and non-biodegradable materials. Currently, Mira Bhayandar Municipal Corporation (MBMC) has no dedicated system to manage reverse logistics for packaging recycling or promote sustainable delivery practices. There is a growing gap between consumption and responsible waste management.**
- 3. Local truck drivers, tempo operators, and delivery riders in Mira Bhayandar, especially those serving the markets in Bhayandar East and Dahisar Check Naka, often lack awareness and training in using digital logistics platforms, GPS tracking, and fuel-optimization apps. As a result, manual paperwork, inefficient fuel use, and non-optimal route selection are common, increasing operational costs and emissions.**
- 4. Many school transportation systems in Mira Bhayandar operate without real-time vehicle tracking or route optimization. Parents have no live updates on bus locations, and inefficient bus routing increases fuel consumption, commute time, and traffic congestion near schools. There is a need to improve safety, reduce carbon footprint, and streamline school logistics**
- 5. During summer months or pipeline maintenance, water tanker services in Mira Bhayandar are in high demand, but the allocation process is manual, unstructured, and prone to delays. Residents often have to call multiple vendors and cannot track arrival times or tanker availability in real-time. This leads to unnecessary waiting, water hoarding, and unfair distribution. There is a need to improve tracking and automated scheduling to improve service efficiency and ensure equitable distribution.**
- 6. With rapid construction in various areas of Mira Bhayandar, material deliveries like cement, bricks, and sand are often unscheduled and untracked, leading to road blockages, dust pollution, and inefficient loading/unloading times. There is need for a smart scheduling and logistics tracking platform for construction materials that can improve urban mobility, minimize environmental impact, and ensure timely project execution.**



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
BSC101	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
BSC101	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In a second-year Information Engineering course, understanding statistical and optimization techniques is essential for analyzing data and improving system efficiency. Large and small sample tests help students make inferences from data—large sample tests apply to big datasets like internet usage logs, while small sample tests are used for limited data, such as evaluating a new data compression method. Chi-square and F-tests are valuable for comparing distributions and variances—for instance, verifying symbol frequencies in encoded messages or comparing network performance under different conditions. The Simplex method enables optimal resource allocation, such as distributing bandwidth among users, while Duality provides deeper insight into constraints and trade-offs. Nonlinear problems, common in signal processing or wireless networks, can be addressed using Kuhn-Tucker conditions to optimize performance within practical limits. Markov Chains model systems with probabilistic transitions, such as user navigation patterns or communication errors. Queuing Theory is vital for analyzing delays and



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

optimizing performance in routers and server systems. These tools equip students with a practical foundation for building efficient and reliable information systems.

Course Objectives:

1. To explain statistical hypothesis testing methods to analyze large and small datasets in IT systems.
2. To describe the use of Chi-square and F-tests for validating relationships and comparing variances in IT data.
3. To understand linear programming to optimize resource allocation in IT project management and network design.
4. To explain the Kuhn-Tucker conditions to solve constrained non-linear optimization problems in IT system design.
5. To describe Markov chain models for stochastic process analysis in IT applications.
6. To understand queuing theory to analyze and improve IT system performance.

Course Outcomes:

1. Students will be able to apply large and small sample tests to assess network traffic data and system reliability metrics.
2. Students will be able to perform chi-square tests to verify user behavior patterns and conduct f-tests to compare performance variance across different software versions.
3. Students will be able to solve optimization problems like bandwidth allocation or cloud resource scheduling using simplex method and interpret dual solutions.
4. Students will be able to formulate and analyze non-linear problems such as optimizing database query performance under resource constraints.
5. Students will be able to model user session behaviors in web applications and predict state transitions in network protocols using Markov chains.
6. Students will be able to analyze server request handling and optimize load balancing in cloud computing environments using queuing models like M/M/1.

Prerequisite:

1. Basic Probability Theory, Matrix Algebra.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Sampling theory-I	Sampling distribution, Test of Hypothesis, Level of Significance, Critical region, One-tailed, and two tailed test, Degree of freedom.	05	CO1
		Test significance for large samples. Test the significance of mean.		
		Students' t-distribution (Small sample). Test the significance of single sample mean and two independent sample means and paired t- test)		
		Self-learning Topics: 1. Estimate parameters of a population. 2. Test of significance of large samples, Proportion test. 3. Difference between the means of two large samples.	08	
II	Sampling theory-II	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction.	05	CO2
		Analysis of variance: F-test (significant difference between variances of two samples).		
		Self-learning Topics: 1. ANOVA: One way classification, 2. ANOVA: Two-way classification (short-cut method).	08	
III	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables.	05	CO3



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Simplex method.		
		Duality, Dual of LPP.		
		Dual Simplex Method.		
		Self-learning Topics: 1. Artificial variable method, Big M method. 2. Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	08	
IV	Nonlinear Programming Problems	NLPP with one equality constraint (two variables) using the method of Lagrange's multipliers	05	CO4
		NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions.		
		Self-learning Topics: 1. NLPP with one inequality constraint (three variables): Kuhn-Tucker conditions. 2. NLPP with one equality constraint (three variables) using the method of Lagrange's multipliers	07	
V	Markov Chains	Introduction to Markov Chains	05	CO5
		Transition Probability matrix, Transition Diagram		
		Homogeneous Markov Chains		
		Chapman-Kolmogorov Equations for discrete Markov chains.		
		Self-learning Topics: 1. Initial Conditions 2. Classification of states 3. Semi-Markov Chains	07	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		4. Markov Processes State Space and Continuous time.		
VI	Queuing Theory	Introduction to Queuing Systems	05	CO6
		Birth-Death Processes & M/M/1 Queues		
		M/M/c and Finite Queue Models		
		M/G/1 and G/G/1 Queues		
		Queuing Networks		
		Self-learning Topics: 1. Priority Queues. 2. Queueing Disciplines. 3. Retrial Queues & Balking/Reneging 4. Queueing with Server Vacations		

Text Books:

1. Operations Research, Hira and Gupta, S. Chand Publication.
2. Fundamentals of Statistics, S. C. Gupta.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
4. Murray Spiegel, "Schaum's Outline of Probability and Statistics", 4th Edition, Tata McGraw-Hill.

References:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley & Sons.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Operations Research: An Introduction, Hamdy A Taha, Pearson.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell.
5. S. D. Sharma, "Operations Research", Kedarnath Ramnath Publishing, Meerut, 8th Edition, 2015.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/117/103/117103017/
2.	https://archive.nptel.ac.in/courses/111/102/111102111/

Assessment:

Term work (TW) for 25 marks:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per the university pattern for practical.
2. Students must be encouraged to write **at least 10** class tutorials on entire syllabus.
3. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project.

This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1. Regularity and active involvement (Theory and Tutorial) 05 marks.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

2. Class Tutorials on entire syllabus 10 marks.

3. Mini Project 10 marks.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211402	Software Engineering & Project Management	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211402	Software Engineering & Project Management	20	20	40	60	2.5	--	--	100

Rationale :

This course equips students with essential software engineering and project management skills. It strategically focuses on Sustainable Digital Supply Chains and Smart Logistics, addressing a critical industry demand. The curriculum aligns with NEP 2020 by offering holistic, multidisciplinary education. It fosters skill-based learning, critical thinking, and problem-solving through practical applications. Emphasis on experiential learning is achieved via real-world case studies and a dedicated project module. Crucially, the course directly contributes to UN Sustainable Development Goals like Responsible Consumption (SDG 12) and Sustainable Cities

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

📞 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

(SDG 11). It also promotes Climate Action (SDG 13) and Innovation (SDG 9) within logistics. The pedagogical approach, guided by Bloom's Taxonomy, ensures comprehensive cognitive development. Graduates will be competent, responsible, and future-ready professionals for a sustainable global economy

Course Objective:

1. To provide the knowledge of software engineering discipline.
2. To understand Requirements and analyze it
3. To do planning and apply scheduling. To apply analysis, and develop software solutions
4. Apply testing and assure quality in software solutions.
5. To understand the need of project management and project management life cycle.
6. To demonstrate and evaluate real time projects with respect to software engineering principles

Course Outcomes:

1. Classify software application domains and compare software development process models. (L2, L4)
2. Develop clear software specifications and apply effective requirement gathering methods. (L3, L4)
3. Convert requirements into design models using sound software and UI design principles. (L3, L6)
4. Distinguish between SCM and SQA, and evaluate testing strategies for effectiveness. (L4, L5)
5. Justify SDLC's role in projects and assess Software Engineering's impact on the Product Life Cycle. (L5)
6. Create project schedules, design network diagrams, and prioritize tasks based on risk. (L3, L5, L6)

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	None	-	-
I	Introduction to Software Engineering	Nature of Software, Software Definition, Software Characteristics, Software Application Domains. Evolution and scope of software engineering. Software process models: Waterfall, Spiral, V-Model, Agile, SCRUM, DevOps. Characteristics of good software (reliability, maintainability, efficiency, etc.) Software engineering ethics and professional conduct. Overview of SDLC and software process activities. Secure Software Development Life Cycle (SSDLC)	8	CO1



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Self-learning Topics: History and Milestones of Software Engineering. In-depth Study of Agile & DevOps Practices. DevOps for Agile Software Delivery. Explore the principles and practices of DevOps, and how they enhance agile methodologies (Scrum(JIRA), XP, KANBAN) for continuous integration, delivery, and deployment in modern supply chain software.	6	
II	Requirements Engineering and Feasibility Analysis	Functional vs Non-functional requirements. Elicitation techniques: Interviews, questionnaires, use cases. Writing Software Requirements Specification (SRS), Request for change (RFC) and PRD (Product Requirement Document) using IEEE standards. Feasibility analysis: Technical, economic, operational. Requirements validation and change management.	7	CO1, CO2
		Self-learning Topics: AI-Powered Requirements Analysis and Automation: Investigate tools and techniques that use AI/ML to assist in requirements gathering (e.g., sentiment analysis of user feedback) and automated test case generation for complex logistics systems.	6	
III	Software Design and Architecture with Implementation	Design principles: Modularity, cohesion, coupling, abstraction. UML diagrams: Class, Use Case, Sequence, Activity. Design patterns: Singleton, Factory, MVC. Software architecture styles: Layered, Client-Server, Microservices. Formulate Architecture Design, Component Level Design, System Level Design. Create User Interface Designs focusing on usability and accessibility. Coding standards (PEP8, MISRA), naming conventions, comments. Procedural vs Object-Oriented Programming (OOP) design.	8	CO1, CO2, CO3, CO4



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Self-learning Topics: Study other patterns for reading here SOLID principles, DRY, KISS(Keep It Simple, Stupid), YAGNI link . Compare Procedural vs. Object-Oriented Programming. Hands-on with Code Reusability Techniques. Study Microservices Architecture in Large-Scale Logistics Systems: Research the benefits and challenges of designing large-scale, distributed logistics applications	8	
IV	Software Testing & Quality Assurance	Software Testing Life Cycle (STLC). Testing types: Unit, Integration, System, Acceptance. White-box & Black-box techniques. Evaluating quality metrics like defect density and test coverage and testing tools such as JUnit (Java), PyTest (Python), and Selenium for automation. Examine the role of reviews, inspections, and audits in ensuring software quality.	8	CO5
		Self-learning Topics: Practice Black-box and White-box Testing Techniques. Study Cybersecurity in IoT-Enabled Supply Chains Study cypress(fronted), Performance Testing(Jmeter),browser testing(Browserstack)	7	
V	Software Project Management & Maintenance	Introduction to software project management principles.Software project lifecycle: Initiation → Closure. Estimation techniques: COCOMO, Function Point. Gantt Charts, PERT, CPM for scheduling. Thread in communication, time management, and teamwork in Project phases. Introduction, 4 P's, W5HH. Risk management and stakeholder communication strategies. Building a Project Charter and Work Breakdown Structure (WBS). GenAI tools for documentation, testing, or coding assistance. Types of maintenance: Corrective, Adaptive, Preventive. Risk Projection and RMMM.	7	CO1, CO2, CO3, CO4, CO6



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Configuration and change management tools.		
		Self-learning Topics: Create a project plan with WBS, estimation & risk register. Risk Management with Artificial Intelligence: Explore how AI and predictive analytics can be used to identify, assess, and mitigate project risks more effectively	6	
VI	Practical Application - Theme Based Case Studies Theme: Sustainable Digital Supply Chains & Smart Logistics Project	AI / ML Integration DevOps, CI/CD & Microservices Cloud-Native & IoT Systems Blockchain & Security in Software Engineering	7	CO1, CO2, CO3, CO4, CO5, CO6
		Case Study 1: Optimizing Last-Mile Delivery for Urban Sustainability Scenario: A large e-commerce company faces challenges with inefficient last-mile delivery in dense urban areas, leading to high fuel consumption, increased carbon emissions, traffic congestion, and customer dissatisfaction due to delayed deliveries. They decide to invest in a "Smart Logistics" software solution. Case Study 2: Implementing a Digital Twin for Green Manufacturing & Supply Chain Transparency Scenario: A manufacturing company producing electronic components aims to achieve greater sustainability by reducing waste, optimizing energy consumption, and ensuring ethical sourcing throughout its supply chain. They decide to develop and implement a "Digital Twin" of their manufacturing process and supply chain. Case Study 3: Blockchain for Ethical Sourcing	12	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		and Supply Chain Traceability Scenario: A fashion brand commits to ensuring ethical sourcing of raw materials (e.g., cotton, dyes) and transparent supply chain practices to prevent child labor and environmental damage. They decide to implement a blockchain-based traceability system for their supply chain. Case Study 4: AI-Powered Demand Forecasting for Waste Reduction in Food Supply Chain Scenario: A large supermarket chain struggles with significant food waste due to inaccurate demand forecasting, leading to overstocking and expired products. They aim to implement an AI/Machine Learning-driven demand forecasting system to optimize inventory and reduce waste. Case Study 5: IoT-Enabled Cold Chain Monitoring for Pharmaceutical Logistics Scenario: A global pharmaceutical company needs to ensure that sensitive vaccines and medicines are maintained within precise temperature ranges throughout their journey from manufacturing plants to hospitals and clinics worldwide. Any deviation can render Case Study 6: AI-Driven Warehouse Automation for Circular Economy Initiatives Scenario: A company specializing in electronics recycling and refurbishment aims to increase its processing efficiency and material recovery rates. They want to implement an "AI-driven warehouse automation" system to sort incoming electronic waste, identify Case Study 7: Predictive Maintenance for Fleet Management in Green Logistics Scenario: A large logistics company with a fleet		



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		of delivery vehicles wants to reduce operational costs, minimize vehicle downtime, and lower carbon emissions by proactively identifying and addressing potential mechanical failures. They aim to implement a "Predictive Maintenance" system using IoT and AI.		

Text Books:

1. Roger S Pressman, "Software Engineering: A Practitioner's Approach," 7th Edition, McGraw-Hill. ISBN: 0073375977.
2. Jack T. Marchewka, "Information Technology Project Management," 4th Edition, Wiley India.
3. Ian Sommerville "Software Engineering" 9th edition Pearson Education SBN-13: 978-0-13-703515-1, ISBN-10: 0-13-703515-2

References:

1. Pankaj Jalote, "Software Engineering: A Precise Approach," Wiley India.
2. Ian Sommerville, "Software Engineering," 9th Edition, Pearson Education. ISBN-13: 978-0-13-703515-1, ISBN-10: 0-13-703515-2.
3. John M. Nicholas, "Project Management for Business and Technology," 3rd Edition, Pearson Education.
4. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management."

Online References:

Sr. No.	Website Name
1.	https://www.ireb.org/en/ (International Requirements Engineering Board (IREB) - CPRE Syllabus)
2.	https://martinfowler.com/ (Martin Fowler's website)
3.	https://www.pmi.org/ (Project Management Institute (PMI))



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15211403	Operating System	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
15211403	Operating System	20	20	40	60	2.5	--		100

Rationale :

Operating Systems form the backbone of computer systems by managing hardware and software resources, enabling efficient and secure application execution. Understanding OS concepts equips engineering students with the skills to design system-level software, handle concurrency, memory, and process management. This foundational knowledge is essential for advanced areas like cloud computing, cybersecurity, embedded systems, and performance optimization.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Objectives:

1. Analyze the fundamental components and operational paradigms of modern Operating Systems.
2. Design and implement process management solutions, including process lifecycle, thread management, and diverse scheduling algorithms.
3. Evaluate inter-process communication mechanisms, mitigate race conditions, and formulate strategies for deadlock prevention and recovery in concurrent systems.
4. Optimize memory allocation and virtual memory techniques to enhance system performance and resource utilization.
5. Secure and manage storage systems, implementing efficient file handling and I/O operations in diverse computing environments.
6. Assess the design principles and operational challenges of special-purpose Operating Systems for emerging technologies, considering their societal and environmental impact.

Course Outcomes:

On successful completion, of course, learner/student will be able to:

1. Explain and classify the core concepts and structures of Operating Systems. (L2, L4)
2. Implement process management policies and analyze the performance of various CPU scheduling algorithms. (L3, L4)
3. Apply synchronization primitives to resolve concurrency issues and propose solutions for deadlock scenarios in multi-threaded applications. (L3, L5)
4. Configure and evaluate memory allocation strategies, and troubleshoot virtual memory issues to improve system efficiency. (L3, L5)
5. Design secure and efficient storage management solutions, and assess the reliability of file systems and I/O operations. (L6, L5)
6. Compare and critique the architecture and functionalities of specialized Operating Systems, considering their application in sustainable development. (L4, L5)

Prerequisite: Programming Language C (with emphasis on pointers and memory management); Basic of Hardware (ALU, RAM, ROM, HDD, CPU Architecture); Computer System Organization.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Programming Language C (with emphasis on pointers and memory management); Basic of Hardware (ALU, RAM, ROM, HDD, CPU Architecture); Computer System Organization.	02	-
I	Fundamentals of Operating System	Introduction to Operating Systems; Goals of OS: Efficiency, Reliability, Security, Adaptability; Operating System Structures (Monolithic, Layered, Microkernel, Modules); System Calls and APIs; OS Services and User Interface; System Programs; Virtualization Concepts (Hypervisors); Boot Process.	4	CO1
		Self-learning Topics: Comparative study of OS architectures (e.g., Linux vs. Windows Kernel); Basics of Containerization (Docker Architecture); Evolution of OS and its impact on digital infrastructure.	5	
II	Process Management	Process Definition and Attributes; Process State Model and Transitions; Process Control Block (PCB); Context Switching; Threads (User vs. Kernel, Threading Models); Concurrency vs. Parallelism; CPU Scheduling Criteria and Algorithms (FCFS, SJF, Priority, Round Robin, Multilevel Queue, Multilevel Feedback Queue); Real-Time	7	CO2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Scheduling (Rate Monotonic, Earliest Deadline First).		
		Self-learning Topics: Performance analysis and benchmarking of scheduling algorithms in different scenarios; Introduction to Container Orchestration (e.g., Kubernetes Pods and Processes); Process isolation for secure applications	6	
III	Process Coordination	Process Coordination and Synchronization Inter-process Communication (IPC) Mechanisms (Shared Memory, Message Passing); Race Conditions and Critical Section Problem; Solutions to Critical Section (Peterson's, Mutex Locks, Semaphores); Classic Synchronization Problems (Producer-Consumer, Dining Philosophers, Readers-Writers); Deadlock: Characterization, Prevention, Avoidance (Banker's Algorithm), Detection, and Recovery.	9	CO3
		Self-learning Topics: Case studies of concurrency issues in real-world distributed systems; Exploring distributed locking mechanisms; Designing fault-tolerant communication systems.	9	
IV	Memory Management	Logical vs. Physical Address Space; Swapping; Contiguous Memory Allocation (Fixed and Variable Partitioning); Fragmentation (Internal and External); Paging (Basic,	9	CO4



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Hierarchical, Hashed Page Tables); Segmentation; Virtual Memory Concepts; Demand Paging; Copy-on-Write (CoW); Page Replacement Algorithms (FIFO, LRU, Optimal, LFU, MFU); Thrashing and its Prevention.		
		Self-learning Topics: Memory management in Cloud VMs; Memory profiling and optimization tools; Impact of efficient memory use on energy consumption	7	
V	Storage Management	File System Concepts; File Access Methods (Sequential, Direct, Indexed); Directory Structures (Single-level, Two-level, Tree-structured); File-System Implementation (Allocation Methods: Contiguous, Linked, Indexed; Free-Space Management); Mass-Storage Structure (Disk Structure, Disk Attachment); Disk Scheduling Algorithms (FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK); RAID Structure; Introduction to I/O Systems (Polling, Interrupts, DMA).	8	CO5
		Self-learning Topics: Distributed File Systems (HDFS, Ceph); Object Storage (e.g., AWS S3 principles); Data durability and resilience in cloud storage.	7	
VI	Special-purpose Operating Systems and Application	Fundamentals of Distributed Operating System; Network Operating System; Embedded	6	CO6



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

	on Operating System	Operating Systems; Real-Time Operating System; Mobile Operating System; Multimedia Operating System; Comparison between Functions of various Special-purpose Operating Systems		
		Case Study 1: Flipkart – Android-Based Delivery Tracking Context: E-commerce logistics across India OS Role: Android provides GPS, camera access, and real-time sync with cloud systems. Case Study 2: Indian Railways – Smart Parcel Management via Android App Context: Parcel logistics optimization OS Role: Android enables mobile-based access to backend systems for real-time data entry and updates. Case Study 3: Microsoft Hyper-V for Sustainable E-Commerce Fulfillment Context: A fast-growing e-commerce startup wanted to expand sustainably while ensuring fast delivery and accurate inventory tracking. Application of Virtualization OS: Using Microsoft Hyper-V, the company virtualized its warehouse management systems and integrated smart logistics solutions in the cloud.	11	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Case Study 4: Deadlock Recovery in Port Logistics Management System Context: A major seaport logistics system handling container tracking and cargo routing experienced deadlocks in its centralized control system during peak cargo movements. Deadlock Problem: • OS-level deadlocks occurred in the process queues managing multiple cranes, trucks, and storage slots. • Processes were stuck waiting for each other's I/O buffers and semaphores. Case Study 5: Memory Management in Warehouse Automation – Flipkart Fulfillment Centers OS Concept: Virtual Memory and Paging Context: Flipkart's automated warehouse systems handle massive logistics data in real-time, including order picking, stock levels, and shipping. OS-Driven Challenge: Real-time processes overwhelmed available physical memory, causing paging delays and system slowdowns during peak shopping seasons.		



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		Case Study 6: Distributed File System in Global Supply Chain – Walmart Logistics OS Concept: Distributed File Systems (DFS), Replication, Consistency Context: Walmart needed a real-time, resilient logistics network to handle deliveries across thousands of stores and warehouses, with minimal environmental impact.		

Text Books:

1. A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2. W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3. A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.

Reference Books:

1. N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
2. A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson.
3. R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 1st ed., 2018.

Online References:

Sr. No.	Website Name
1.	https://www.nptel.ac.in (Look for Operating Systems courses)
2.	https://swayam.gov.in (Search for Operating Systems and related topics)
3.	https://www.coursera.org/ (Courses on OS, Cloud Computing, DevOps)
4.	https://developer.android.com/ (For Mobile OS insights)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

5.	https://docs.docker.com/ (For Containerization concepts)
6.	https://kubernetes.io/docs/ (For Orchestration concepts)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15212404	SysOps Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15212404	SysOps Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To develop foundational skills in Linux system administration, including user management, file operations, and process handling
2. To introduce core DevOps principles and practices including DevSecOps, SRE, and NoOps.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

3. To enable effective use of Git and GitHub/GitLab for version control and collaborative software development.
4. To equip students with the ability to write and use shell scripts for automating system and administrative tasks.
5. To train students in configuration management, containerization, and building CI/CD pipelines using tools like Ansible, Docker, and Jenkins.
6. To provide knowledge of secure DevOps practices, monitoring systems, and logging tools aligned with modern observability and SRE frameworks.

Lab Outcomes:

1. Identify basic Linux commands, file structures, user permissions, and process management features. (L1)
2. Explain core concepts of DevOps, DevSecOps, SRE, and NoOps, and differentiate them from traditional IT operations.(L2)
3. Demonstrate the use of Git commands for version control and collaborate using GitHub/GitLab.(L3)
4. Analyze system performance using monitoring tools like Prometheus, Grafana, and ELK Stack to identify bottlenecks and reliability issues.(L4)
5. Evaluate the effectiveness of CI/CD pipelines and DevSecOps practices in improving deployment frequency, security, and system uptime.(L5)
6. Design and develop automated infrastructure solutions using Ansible, Docker, and Jenkins to implement end-to-end DevOps workflows.(L6)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Install and Configure Linux OS (Ubuntu/CentOS) on a virtual machine or bare metal	1
02	Create and manage user accounts, permissions, and directories using Linux commands (useradd, chmod, chown, etc.).	1
03	Write a basic shell script to automate backup of user home directories.	2
04	Initialize a local Git repository, perform commits, create branches, and merge changes.	1
05	Collaborate on GitHub/GitLab by pushing code, creating pull requests (PRs), and resolving merge conflicts.	2



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Sr No	List of Experiments	Hrs
01	Install and Configure Linux OS (Ubuntu/CentOS) on a virtual machine or bare metal	1
02	Create and manage user accounts, permissions, and directories using Linux commands (useradd, chmod, chown, etc.).	1
03	Write a basic shell script to automate backup of user home directories.	2
04	Initialize a local Git repository, perform commits, create branches, and merge changes.	1
05	Collaborate on GitHub/GitLab by pushing code, creating pull requests (PRs), and resolving merge conflicts.	2
06	Develop a shell script to monitor CPU, memory, and disk usage, and send alerts if thresholds are exceeded.	1
07	Write a script to automate user creation, group assignment, and password setup.	2
08	Use grep, awk, and sed in scripts for text processing and log file filtering.	1
09	Write and execute an Ansible playbook to install and configure an Apache or NGINX web server on multiple virtual machines.	2
10	Dockerize a simple Linux-based script or C application, build a Docker image, and run it as a container.	2
11	Create a basic CI pipeline using GitHub Actions or Jenkins to compile and test a C/Linux program.	1
12	Perform static and dynamic code analysis using SonarQube (SAST) and Trivy/OWASP ZAP (DAST) on a sample application.	2
13	Use netstat and nmap to scan running services and ports, and automate the results in a report with a shell script.	2
14	Manage secrets securely in a CI/CD pipeline using GitHub Secrets or Vault.	1
15	Set up Prometheus and Grafana for real-time system monitoring and create a basic dashboard to visualize metrics.	1

Sr No	List of Assignments / Tutorials	Hrs
01	Install a Linux distribution (Ubuntu or CentOS) on a VM. Create users, set permissions, and demonstrate 5 essential file operations.	1
02	Write a Bash script to automate daily backup of user home directories and schedule it using cron.	1

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

03	Initialize a Git repository, create a feature branch, commit changes, and push to GitHub. Create and merge a Pull Request.	1
04	Write an Ansible playbook to install and configure Apache/NGINX on multiple virtual machines.	1
05	Containerize a shell script that monitors CPU and memory usage. Build and run the Docker container.	1
06	Create a simple CI pipeline using GitHub Actions or Jenkins to build and test a C/Linux program.	1
07	Perform static and dynamic code analysis using SonarQube and Trivy on a sample codebase.	1
08	Install and configure Prometheus and Grafana. Monitor CPU/memory and create a dashboard with at least two metrics.	1

Text Books:

1. The Linux DevOps Handbook by Damian Wojsław & Grzegorz Adamowicz
2. The Linux Command Line by William E. Shotts
3. How Linux Works: What Every Superuser Should Know (3rd Edition) by Brian Ward
4. Accelerate: The Science of Lean Software and DevOps by Nicole Forsgren, Jez Humble & Gene Kim
5. The DevOps Handbook by Gene Kim, Jez Humble, Patrick Debois & John Willis

References:

- The Linux Documentation Project. (n.d.). Linux System Administrator's Guide. Retrieved from <https://www.tldp.org/LDP/sag/html/index.html>
- Medium. (2021). *DevOps: Complete CI/CD Pipeline Setup*. Retrieved from <https://medium.com/@abhishekjain.wisdom/devops-complete-ci-cd-pipeline-setup-d64b410f3240>
- Docker Inc. (n.d.). *Get Started with Docker*. Retrieved from <https://docs.docker.com/get-started/>



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

- Kubernetes. (n.d.). *Kubernetes Basics*. Retrieved from <https://kubernetes.io/docs/tutorials/kubernetes-basics/>
- Red Hat. (n.d.). *Viewing Logs with Journalctl*. Retrieved from https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/7/html/system_administrators_guide/sec-viewing_logs_with_journalctl

Online Resources:

Sr. No.	Website Name
1.	Linux From Scratch (linuxfromscratch.org)
2.	Awesome DevOps Books on GitHub
3.	Google SRE Book (O'Reilly)

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals' based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15212405	IDEA LAB -4 (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
15212405	IDEA LAB -4 (Innovation Design Engineering and Apply)	--	--	--	--	50	50	100



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Rationale :

Aligned with the National Education Policy (NEP) 2020, the institution emphasizes experiential, interdisciplinary, and project-based learning through the IDEA Lab—a central hub for hands-on innovation.

To strengthen the undergraduate research ecosystem, the institution has adopted a theme-based academic model aligned with UN SGD. Each semester features six curated problem statements based on local need and aligned with core subjects in the same semester, enabling students to apply classroom knowledge to real-world challenges. Every student selects one problem and develops an individual, subject-integrated solution—enhancing both academic understanding and research skills.

The IDEA Lab supports this initiative with facilities for design thinking, prototyping, and product development. Students maintain a project logbook throughout the semester to track their progress and reflections.

To ensure academic accountability, a two-tier assessment framework is implemented:

- Project Assessment based on standardized IDEA Lab rubrics.
- Subject-Based Term Work Assessment focused on the application of same-semester subject knowledge in the project.

Lab Objectives:

1. To promote experiential and project-based learning that bridges theoretical knowledge with real-world problem-solving.
2. To encourage interdisciplinary integration by enabling students to apply concepts from multiple subjects within a single cohesive project.
3. To develop innovation and design thinking skills through hands-on activities and iterative solution development.
4. To foster critical thinking and creativity by engaging students in open-ended problems with multiple solution pathways.
5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable,



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

1. Recall and articulate key concepts from core and allied subjects relevant to the assigned project.
2. Explain the interdisciplinary nature of the problem and the role of each subject in addressing it.
3. Apply appropriate tools, techniques, and theoretical knowledge to develop project components.
4. Analyze problem constraints and user requirements to structure a feasible and efficient solution.
5. Evaluate multiple design options and justify the chosen solution based on technical and practical considerations.
6. Create a functional prototype or solution that demonstrates innovation, utility, and integration of interdisciplinary knowledge

1) Guidelines for IDEA Project

a) Project Guidelines (Interdisciplinary Project Execution in IDEA Lab)

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation, documentation, and ownership.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.



R-2025- S.E Information Technology

- Faculty in-charges must attend relevant FDPs to ensure uniformity in mentoring and evaluation.

b) Guidelines for same semester Subject Concepts Applied within the Project

- Termwork for each subject will partially reflect how well a student applies subject-specific concepts in their interdisciplinary project.
- Internal assessment panel will collaborate to align project components with subject learning outcomes.

c) Role of Faculty In-Charges in IDEA Lab Projects

Faculty in-charges play a pivotal role in the success of interdisciplinary, theme-based projects under the IDEA Lab. Their responsibilities extend beyond technical supervision to include academic alignment, innovation facilitation, and active student engagement. Their key roles include:

- 1. Motivating and Inspiring Students**
 - Encourage students to take ownership of their learning and projects.
 - Cultivate a mindset of curiosity, exploration, and social relevance.
 - Foster an environment where students feel empowered to take creative risks.
- 2. Conducting Brainstorming and Ideation Sessions**
 - Organize structured brainstorming sessions at the start of the semester to help students define their problem statements and solution pathways.
 - Promote collaborative thinking, design exploration, and interdisciplinary integration.
- 3. Arranging Guest Lectures and Expert Talks**
 - Identify and invite industry experts, researchers, and innovators for guest lectures aligned with the semester's theme or subject areas.
 - Facilitate exposure to real-world challenges, current trends, and future opportunities.
- 4. Ensuring Uniqueness and Originality of Projects**
 - Actively review proposed ideas to ensure **no duplication of solutions** across students.
 - Encourage students to explore novel approaches, technologies, and perspectives.
- 5. Promoting Discussion and Collaborative Learning**



R-2025- S.E Information Technology

- o Create platforms for students to present, discuss, and receive peer and mentor feedback.
- o Facilitate idea refinement through regular discussions and group engagement.
- 6. **Aligning Subject Content Beyond Syllabus**
 - o Faculty in-charges must **align subject content beyond the syllabus of the same semester** with the **IDEA Lab theme and assigned problem statements**.
 - o This ensures relevance, depth, and meaningful interdisciplinary integration.
- 7. **Same Semester Faculty Requirement**
 - o Faculty in-charges must be teaching subjects in the **same semester** as the students' project to ensure seamless academic integration and contextual understanding.
- 8. **Monitoring and Documentation**
 - o Oversee project logbook maintenance, milestone tracking, and submission of progress reports.
 - o Provide ongoing feedback and ensure project alignment with learning outcomes.
- 9. **Coordination with Subject Faculty**
 - o Work in collaboration with other subject faculty to help students embed theoretical and practical aspects of their coursework into the project.
 - o Facilitate subject-term mapping and contribute to termwork assessment based on evidence.

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.
Mentoring Role	Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.
Capacity Building	Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.
Assessment Contribution	Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Aspect	Implementation Strategy
Recognition & Incentives	Faculty in-charges receive workload credits or are formally acknowledged in performance reviews.

b) Implementation of Subject-Term Work Mapping within Projects

Aspect	Implementation Strategy
Mapping Subject Outcomes	Faculty in-charges align their content beyond syllabus with the student's project by coordinating with the assigned project guide.
Independent Evaluation	Internal assessment panel evaluate students based on their application of subject-specific concepts within the project. This contributes to a separate 25 marks allocated for termwork based on subject application.
Evidence Sources	Evaluation is supported by project logbooks, subject-specific deliverables (e.g., tools, simulations, models), and review presentation inputs.
Outcome Assurance	Ensures practical demonstration of subject understanding and its integration into the interdisciplinary solution.

Implementation Notes:

- Guide faculty assess their course's contribution using specific evidence such as:
 - Logbooks
 - Subject-specific outputs (e.g., simulations, designs)
 - Paper publications or review presentations

2) Guidelines for Assessment

Two-tier rubrics are applied independently to evaluate subject concept application and innovation within the project.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

Assessment Month	Weightage	Marks
Month 1 (Formative 1)	20%	5 marks
Month 2 (Formative 2)	40%	10 marks
Month 3 (Formative 3)	40%	10 marks

Rubric-Based Evaluation Criteria

Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
Problem Understanding	Connects problem to subjects	Defines interdisciplinary scope	Demonstrates deep conceptual grasp
Subject Knowledge Application	Identifies relevant concepts	Applies principles in design	Integrates multiple subject areas correctly
Innovation & Design Thinking	Proposes creative idea	Develops and tests feasible solution	Final solution shows originality and utility
Documentation & Presentation	Logbook initiated, plan presented	Mid-design log and visuals	Final report and demo completed
Progress & Ownership	Meets deadlines, shows planning	Demonstrates self-motivation	Completes project independently with reflection

b) Term Work Assessment of Subject Concepts Applied in Projects (25 Marks)

Applicable to All Subjects Integrated with Interdisciplinary Projects

To reflect meaningful application of subject knowledge, each subject will be assessed through the following rubric:



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project
Practical Design or Tool Usage	5	Use of subject-specific hardware/software/simulation/tools
Documentation	4	Quality and clarity of subject-related logs and reports
Viva/Presentation	4	Ability to explain subject's relevance and role in the project
Continuous Engagement	4	Evidence of consistent participation via logbooks and feedback

c) Total Assessment Structure

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide
Termwork – Application of Subject Concepts	25 Marks	IDEA Lab Panel
Viva Voce (Final Evaluation)	50 Marks	External Examiner



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
15412406	Full Stack Development	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
15412406	Full Stack Development	--	--	--	--	--	25	25	50

Lab Objectives:

1. To learn the fundamentals of Java and OOP principles.
2. To build backend applications using Spring Boot and REST APIs.
3. To develop frontend interfaces using HTML, CSS, and JavaScript.
4. To connect and perform CRUD operations with databases.
5. To deploy full stack apps and practice DevOps basics.
6. To promote self-learning using Git, Docker, and modern tools.

Lab Outcomes:

1. Understand and apply Java programming fundamentals including OOPs concepts. (LO1)
2. Build a responsive frontend using HTML, CSS, and JavaScript. (LO1)
3. Develop backend services and REST APIs using Spring Boot. (LO2)
4. Integrate frontend and backend and perform data operations using databases. (LO3, LO4)

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

📞 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

5. Demonstrate skills in deploying full stack apps using Docker and cloud platforms.(LO4)
6. Utilize GitHub, Postman, and modern tools for full stack development workflow. (LO5,LO6)

List of Experiments:

Sr No	List of Experiments	Hrs.
01	Write a Java program to demonstrate class, object, and constructors	1
02	Implement method overloading and overriding using inheritance	2
03	Demonstrate file handling (read/write to file) and exception handling in Java	1
04	Use Java Collections (List, Set, Map) to perform basic data storage operations	2
05	Create and manage threads in Java using Thread class and Runnable interface	1
06	Design a responsive web page using HTML5 and CSS3 with Bootstrap	2
07	Build an interactive form and validate inputs using JavaScript and DOM manipulation	1
08	Set up a Spring Boot project and expose a simple REST API using @RestController	1
09	Test the REST API using Postman (GET, POST, PUT, DELETE) and analyze HTTP responses	2
10	Connect Spring Boot to MySQL/PostgreSQL using Spring Data JPA and perform CRUD operations	1
11	Implement entity relationships (OneToMany, ManyToOne) using JPA annotations	2
12	Integrate frontend HTML/JS form with Spring Boot backend using fetch/axios	2
13	Dockerize a Spring Boot application and run it as a container	1
14	Deploy the backend app to Heroku and frontend (static) to Netlify/Vercel	1
15	Capstone Project: Build and present a complete full stack app (e.g., To-Do List, Student Portal, Inventory System)	2

Sr No	List of Assignments / Tutorials	Hrs



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

01	Describe primitive data types in Java and explain the use of if, switch, for, while, and do-while with examples.	1
02	Define and explain the four pillars of OOP: Encapsulation, Inheritance, Polymorphism, and Abstraction with real-life analogies.	1
03	Write a comparative analysis of ArrayList, HashSet, and HashMap in terms of structure, use cases, and performance.	1
04	Discuss types of exceptions, try-catch-finally structure, and basic file reading/writing using FileReader and BufferedWriter.	1
05	Explain how each technology contributes to building modern, interactive, and responsive websites.	1
06	Define REST APIs and describe how Controllers, Services, and Dependency Injection work together in a Spring Boot application.	1
07	Explain how CRUD operations are performed using JpaRepository and annotate entity classes for one-to-one/many relationships.	1
08	Write an overview of CI/CD pipelines, environment variables, Docker containers, and version control using GitHub.	1

Text Books:

1. "Java: The Complete Reference" by Herbert Schildt
2. "Head First Java" by Kathy Sierra and Bert Bates
3. "HTML and CSS: Design and Build Websites" by Jon Duckett
4. "Pro Spring Boot 3" by Felipe Gutierrez
5. "Docker Deep Dive" by Nigel Poulton

References:

1. Herbert Schildt – *Java: The Complete Reference*
2. Craig Walls – *Spring in Action*
3. Kirupa Chinnathambi – *Learning React*
4. Josh Long – *Spring Boot: Up and Running*

Online References:

Sr. No.	Website Name
1.	https://docs.oracle.com/javase

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

📞 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

2.	https://spring.io – Official Spring Boot Docs
3.	https://reactjs.org – React Documentation
4.	https://getbootstrap.com – Bootstrap Docs
5.	https://www.w3schools.com – HTML/JS/CSS

Assessment:

- **Term Work Marks:** 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Capstone Project) + 5 Marks (Attendance)
- **Practical & Oral Exam:** An Oral & Practical exam will be held based on the above syllabus.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
9951149WW	Open Elective	2	-	-	2	-	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT 1	IAT 2	Total .					
9951149WW	Open Elective	--	--	--	--	--	25	--	25

Students must select a course for Open Elective from a bucket provided by the Rahul Education Group.

Term Work Assessment: 25 Marks (Total marks) = 15 Marks (Case Study/Activity) + 5 Marks (Assignments) + 5 Marks (Attendance)



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451410	Design Thinking	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98451410	Design Thinking	20	20	40	60	2.5	--	--	100

Rationale :

Design Thinking is a human-centered approach that fosters creativity, empathy, and problem-solving. This course equips students with tools to understand user needs, generate innovative ideas, and develop practical solutions for real-world challenges.

Course Objectives:

1. Introduce the core principles and stages of the Design Thinking process.
2. Develop an empathetic mindset to understand user needs.
3. Frame clear problem statements using user-centered tools.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

4. Apply ideation techniques to generate creative solutions.
5. Understand various types of prototypes and their role in product development.
6. Learn the process of testing and refining ideas based on feedback.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Compare traditional and design thinking-based approaches to problem solving.
2. Define user personas using empathy and mapping techniques.
3. Frame actionable problem statements using POV and problem definition tools.
4. Apply ideation techniques to develop diverse solution sets.
5. Differentiate between low and high-fidelity prototypes and understand their usage.
6. Explain how to test prototypes based on desirability, feasibility, and usability..

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills		
I	Introduction to Design Thinking	Introduction to Design Thinking: Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)	4	CO1
		Self-learning Topics: Design thinking case studies from various domains. Link: https://www.design-thinking-association.org/explore-design-thinking-to	4	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		pics/external-links/design-thinking-case-study-index		
II	Empathy	Foundation of empathy, Purpose of empathy, Observation for empathy, User observation technique, Creation of empathy map.	5	CO2
		Self-learning Topics: Creation of empathy maps Link: https://www.interaction-design.org/literature/topics/empathy-mapping Case Study: Designing MRI for Children – GE Healthcare	5	
III	Define	Significance of defining a problem, Rules of prioritizing problem solving, Conditions for robust problem framing, Problem statement and POV	5	CO3
		Self-learning Topics: Creating a Persona – A step-by-step guide with tips and examples Link: https://uxpressia.com/blog/how-to-create-persona-guide-examples	5	
IV	Ideate	What is ideation? Need for ideation, Ideation techniques, Guidelines for ideation: Multi-disciplinary approach, Imitating with grace, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping	6	CO4
		Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide Link:	6	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		https://uxplanet.org/how-to-run-an-effective-ideation-workshop-a-step-by-step-guide- d520e41b1b96		
V	Prototype	Low and high-fidelity prototypes, Paper prototype, Story board prototype, Scenario Prototype.	4	CO5
		Self-learning Topics: IDEO Prototyping Toolkit	4	
VI	Test	5 guidelines of conducting test, The end goals of test: Desirability, Feasibility and Viability, Usability testing	6	CO6
		Self-learning Topics: Real-world Testing Examples from Stanford d.school or IDEO Case Study: IDEO's Shopping Cart Redesign – A classic innovation sprint (All stages)	6	

Textbooks:

1. Design Your Thinking: The Mindsets, Toolsets, and Skill Sets for Creative Problem-solving, Pavan Soni, Penguin, Random House India Private Limited
2. Design Thinking: Methodology Book, Emrah Yayichi, 2016
3. Handbook of Design Thinking: Christian Mueller-Roterberg, 2018

Reference books:

1. Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School, Idris Mootee, Wiley, 2013
2. Change by Design, Tim Brown, Harper Business, 2009

Online References:

Sr. No.	Website Name
1.	Design Thinking and Innovation by Ravi Poovaiah https://onlinecourses.swayam2.ac.in/aic23_ge17/preview
2.	Introduction to Design Thinking by Dr. Rajeshwari Patil, Dr. Manisha Shukla,



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

	Dr Deepali Raheja, Dr. Mansi Kapoor https://onlinecourses.swayam2.ac.in/imb24_mg37/preview
3.	Usability Testing https://www.interaction-design.org/literature/topics/usability-testing



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98431411	Business Model Development	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98431411	Business Model Development	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is the backbone of innovation and economic growth. In the 21st-century knowledge economy, students must be equipped not just with employment-ready skills but with a problem-solving and innovation mindset to become job creators. This course blends core entrepreneurship principles with business model design, startup financing, and digital business strategies.

Course Objectives:

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

1. To introduce students to entrepreneurship and its socio-economic relevance.
2. To enable understanding of different business structures and MSME significance.
3. To familiarize learners with funding mechanisms for startups.
4. To introduce the basics of IPR and ethical innovation practices.
5. To equip students with tools for building business models and MVPs.
6. To explore digital marketing and disruption in online business ecosystems.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Define and explain entrepreneurship and its key types.
2. Analyze the legal and operational structure of business ownership.
3. Identify and compare startup funding models and sources.
4. Apply the fundamentals of IPR to protect entrepreneurial innovations.
5. Create comprehensive business models using BMC tools.
6. Evaluate and apply digital marketing techniques for online business models.

Prerequisite: Basic Design Thinking principles.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Design Thinking principles	1	
I	Introduction to Entrepreneurship	Definition, the role of entrepreneurship in the economic development, The entrepreneurial process, Women entrepreneurs, Corporate entrepreneurship, Entrepreneurial mindset.	5	CO1
		Self-learning Topics: Case studies: Henry Ford https://www.thehenryford.org/docs/default-source/default-document-library/	5	



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

		default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business		
II	Entrepreneurship Development	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development.	4	CO2
		Self-learning Topics: MSME Act and Udyam Registration portal Case Study: Amul – Co-operative innovation in dairy sector	4	
III	Start-up financing	Start-up financing: Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes funding(e.g., SIDBI, Startup India).	4	CO3
		Self-learning Topics: Successful business pitching. Case Study: Shark Tank pitch breakdown.	4	
IV	Intellectual Property Rights (IPR)	Types of IPR: Patents, trademarks and copyrights, Patent search and analysis, Strategies for IPR protection, Ethics in technology and innovation.	4	CO4
		Self-learning Topics: Case Study: WIPO Patent Search Exercise	4	
V	Business Model	Types of business models, Value proposition, Customer	4	CO5



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

	Development	segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.		
		Self-learning Topics: The Art of the Start 2.0: The Time-Tested, Battle- Hardened Guide for Anyone Starting Anything by Guy Kawasaki Case Study: The Rise of Zomato – A Disruptive Food Delivery Platform	4	
VI	Digital Business Management	Digital Business models (Subscription, Freemium etc), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business.	4	CO6
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	4	

Sr No	List of Assignments	Hrs
01	Presentation on case study of a failed business model	2
02	Presentation on case study of a woman entrepreneur	2

Textbooks:

1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E- Commerce Management: Strategy, Implementation,



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Programs | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- S.E Information Technology

Practice – Dave Chaffey, Pearson Education

Reference books:

1. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
2. E- Business & E- Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education

Online References:

Sr. No.	Website Name
1.	Startup India Portal – https://www.startupindia.gov.in
2.	Entrepreneurship by Prof. C Bhaktavatsala Rao https://onlinecourses.nptel.ac.in/noc20_mg35/preview
3.	Innovation, Business Models and Entrepreneurship by Prof. Rajat Agrawal, Prof. Vinay Sharma https://onlinecourses.nptel.ac.in/noc21_mg63/preview
4.	Sarasvathy's principles for effectuation https://innovationenglish.sites.ku.dk/model/sarasvathy-effectuation/
5.	WIPO Patent Search https://www.wipo.int/portal/en/index.html
6.	Airbnb Business Model Case https://www.prismatic.com/airbnb-business-model/
7.	BMC Tool https://www.strategyzer.com/canvas/business-model-canvas

Assessment:

Term Work: Term Work shall consist of at least 4 to 5 **Case Study Analysis , Presentation** based on the above list. Also, Term work Journal must include at least 2 to 3 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Case Study report)+ 5 Marks (Assignments) + 5 Marks (Attendance).



R-2025- S.E Information Technology

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
98471412	Audit Course (non-graded)	3	-	-	3	-	-	-

Audit Course: Career Readiness for Students

This audit course is a strategic offering designed to significantly enhance students' preparedness for the professional world, extending their educational experience beyond the confines of their core curriculum. Students who opt to audit this course will actively participate in class discussions and complete assigned work, gaining invaluable skills and insights without the pressure of formal examinations or academic credit.

Course Objectives:

The primary aim of this course is to equip students with the essential tools and confidence needed to navigate the contemporary job market successfully. By the end of this course, students will be able to:

- Master key concepts and problem-solving techniques for aptitude tests.
- Develop critical soft skills necessary for professional interactions and interviews.
- Construct impactful resumes that effectively highlight their strengths and experiences.
- Optimize their LinkedIn profiles for professional networking and job search opportunities.

Course Structure:

The course shall be delivered in Semester 4 and 5 and is structured around three weekly lectures, each dedicated to a vital aspect of career readiness. The emphasis will be on interactive sessions, practical exercises, and real-world application to foster deep learning and skill development. To ensure relevance and specialized learning, each department is empowered to customize the course content based on their unique discipline.



R-2025- S.E Information Technology

T.E Syllabus

SEM 5



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC501	Internet Programming	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC501	Internet programming	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To orient students to Web Programming fundamental.
2	To expose students to JavaScript to develop interactive web page development
3	To orient students to Basics of REACT along with installation
4	To expose students to Advanced concepts in REACT
5	To orient students to Fundamentals of node.js
6	To expose students to node.js applications using express framework.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Select protocols or technologies required for various web applications.	L1,L2,L3,L4
2	Apply JavaScript to add functionality to web pages.	L1, L2, L3
3	Design front end application using basic React.	L1,L2,L3,L4,L5,L6
4	Design front end applications using functional components of React.	L1,L2,L3,L4,L5,L6
5	Design back-end applications using Node.js.	L1,L2,L3,L4,L5,L6
6	Construct web based Node.js applications using Express.	L1,L2,L3,L4,L5,L6



Prerequisite: Knowledge of basic programming, network fundamentals and operating systems.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Introduction and basics of HTML, CSS	02	-
I	Web programming fundamentals	Working of web browser, HTTP protocol, HTTPS, DNS, TLS, XML introduction, Json introduction, DOM, URL, URI, REST API. Self-learning Topics: : Nginx server	03	CO1
II	Javascript:	Introduction to ES6, Difference between ES5 and ES6. Variables, Condition, Loops, Functions, Events, Arrow functions, Setting CSS Styles using JavaScript, DOM manipulation, Classes and Inheritance. Iterators and Generators, Promise, Client-server communication, Fetch Self-learning Topics: Asynchronous JavaScript, JSON	06	CO2
III	React fundamentals	Installation, Installing libraries, Folder and file structure, Components, Component lifecycle, State and Props, React Router and Single page applications, UI design, Forms, Events, Animations, Best practices. Self-learning Topics: React vs Angular vs Vue	07	CO3
IV	Advanced React	Functional components- Refs, Use effects, Hooks, Flow architecture, Model-View-Controller framework, Flux, Bundling the application. Web pack. Self-learning Topics: React Native	07	CO4
V	Node.js	Environment setup, First app, Asynchronous programming, Callback concept, Event loops, REPL, Event emitter, Networking module, Buffers, Streams, File system, Web module. Self-learning Topics: Node.js with MongoDB.	07	CO5



R-2025- T.E INFORMATION TECHNOLOGY

VI	Express:	Introduction, Express router, REST API, Generator, Authentication, sessions, Integrating with React. Self-learning Topics: Commercial deployment.	07	CO6

Text Books:

1. Rediscovering JavaScript, Master ES6, ES7, and ES8, By Venkat Subramaniam · 2018
2. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly
3. Learning Redux, Daniel Bugl, Packt Publication
4. Learning Node.js Development, Andrew Mead, Packt Publishing
5. RESTful Web API Design with Node.js 10, Valentin Bojinov, Packt Publication

References:

1. Web Development with Node and Express, Ethan Brown, O'Reilly

Online Resources:

1. <https://reactjs.org/tutorial/tutorial.html>
2. <https://react-redux.js.org/introduction/quick-start>
3. <https://webpack.js.org/>
4. <https://www.youtube.com/watch?v=-27HAh8c0YU>



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC502	Computer Network Security	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC502	Computer Network Security	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	The basic concepts of computer and Network Security
2	Various cryptographic algorithms including secret key management and different authentication techniques.
3	Different types of malicious Software and its effect on the security.
4	Various secure communication standards including IPsec, SSL/TLS and email.
5	The Network management Security and Network Access Control techniques in Computer Security.
6	Different attacks on networks and infer the use of firewalls and security protocols.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the fundamentals concepts of computer security and network security.	L1, L2
2	Identify the basic cryptographic techniques using classical and block encryption methods.	L1
3	Study and describe the system security malicious software.	L1, L2
4	Describe the Network layer security, Transport layer security and application layer security.	L1, L2
5	Explain the need of network management security and illustrate the need for NAC.	L1, L2
6	Identify the function of an IDS and firewall for the system security.	L1,L2, L3

Prerequisite: Basic concepts of Computer Networks & Network Design, Operating System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic concepts of Computer Networks & Network Design, Operating System	02	--
I	Introduction to Network Security & cryptography	Computer security and Network Security(Definition), CIA, Services, Mechanisms and attacks, The OSI security architecture, Network security model. Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher, transposition techniques: keyed and keyless transposition ciphers). Introduction to steganography. Self-learning Topics: Study some more classical encryption techniques and solve more problems on all techniques. Homomorphic encryption in cloud computing	07	CO1



R-2025- T.E INFORMATION TECHNOLOGY

II	Cryptography: Key management, distribution and user authentication	Block cipher modes of operation, Data Encryption Standard, Advanced Encryption Standard (AES). RC5 algorithm. Public key cryptography: RSA algorithm. Hashing Techniques: SHA256, SHA-512, HMAC and CMAC, Digital Signature Schemes – RSA, DSS. Remote user Authentication Protocols, Kerberos, Digital Certificate: X.509, PKI Self-learning Topics: Study working of elliptical curve digital signature and its benefits over RSA digital signature.	09	CO2
III	Malicious Software	SPAM, Trojan horse, Viruses, Worms, System Corruption, Attack Agents, Information Theft, Trapdoor, Keyloggers, Phishing, Backdoors, Rootkits, Denial of Service Attacks, Zombie Self-learning Topics: Study the recent malicious software's and their effects.	04	CO3
IV	IP Security, Transport level security and Email Security	IP level Security: Introduction to IPSec, IPSec Architecture, Protection Mechanism (AH and ESP), Transport level security: VPN. Need Web Security considerations, Secure Sockets Layer (SSL) Architecture, Transport Layer Security (TLS), HTTPS, Secure Shell (SSH) Protocol Stack. Email Security: Secure Email S/MIME Screen reader support enabled. Self-learning Topics: Study Gmail security and privacy from Gmail help	07	CO4
V	Network Management Security and Network Access Control	Network Management Security: SNMPv3, NAC: Principle elements of NAC, Principle NAC enforcement methods, How to implement NAC Solutions, Use cases for network access control Self-learning Topics: Explore any open source network management security tool	06	CO5
VI	System Security	IDS, Firewall Design Principles, Characteristics of Firewalls, Types of Firewalls Self-learning Topics: Study firewall rules table	04	CO6

Textbooks:

- 1 William Stallings, Cryptography and Network Security, Principles and Practice, 6th Edition, Pearson Education, March 2013.
- 2 Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill.
- 3 Mark Stamp's Information Security Principles and Practice, Wiley
- 4 Bernard Menezes, "Cryptography & Network Security", Cengage Learning.



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

References:

- 1 Applied Cryptography, Protocols, Algorithms and Source Code in C, Bruce Schneier, Wiley.
- 2 Cryptography and Network Security, Atul Kahate, Tata Mc Graw Hill.
- 3 www.rsa.com

Online References:

Sr. No.	Website Name
1.	https://swayam.gov.in/
2.	https://nptel.ac.in/
3.	https://www.coursera.org/



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC503	Entrepreneurship and E-business	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	Test2	Total					
ITC503	Entrepreneurship and E-business	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Distinguish Entrepreneur and Entrepreneurship starting and feasibility study.
2	Realize the skills required to be an entrepreneur
3	Acquaint the students with challenges of starting new ventures
4	Identify the right sources of fund for starting a new business
5	Be familiarized with concept of E-business Models.
6	Understand various E-business Strategies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1		L1,L2
2	Understand the nature of business development in the context of existing organizations and of new business start-ups.	L1,L2
3	Comprehended important factors for starting a new venture and business development.	L1,L2,L3



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

4	Know issues and decisions involved in financing and resourcing a business start-up	L1,L2,L3,L4
5	Describe various E-business Models	L1,L2,L3,L4
6	Discuss various E-business Strategies.	L1,L2,L3,L4

Prerequisite: None

DETAILED SYLLABUS:

Sr No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	None	--	--
I	Introduction	Concept, meaning and definition of Entrepreneur and Entrepreneurship. Evolution of Entrepreneurship, Role of Entrepreneurship in economic Development; Managerial vs entrepreneurial approach; Classification and types of Entrepreneurs. Characteristics and qualities of successful Entrepreneurs; Women Entrepreneurs; Corporate & Social entrepreneurship. Self-learning Topics: Factors impacting emergence of entrepreneurship.	04	CO1
II	Entrepreneurship Development and Leadership	Entrepreneurial Motivation: motivating factors, Types of startups; Characteristics of entrepreneurial leadership, Components of Entrepreneurial Leadership; Factors influencing entrepreneurial development and motivation, Entrepreneurial Opportunities and challenges, Entrepreneurship process. Types of Enterprises and Ownership Structure: small scale, medium scale and large-scale enterprises: Meaning and definition (evolution), role of small enterprises in economic development; proprietorship, Policies governing SMEs, partnership, Ltd. companies and co-operatives: their formation, capital structure and source of finance. Self-learning Topics: study the white paper https://www.ncert.nic.in/ncerts/l/lebs213.pdf	06	CO2



R-2025- T.E INFORMATION TECHNOLOGY

III	New Venture Planning	Methods to Initiate Ventures; Acquisition-Advantages of acquiring an ongoing venture and examination of key issues; Developing a Marketing plan-customer analysis, sales analysis and competition analysis, Business Plan-benefits of drivers, perspectives in business plan preparation, elements of a business plan; Business plan failures. Self-learning Topics: Refer following URL to study various case studies https://www.entrepreneurindia.co/case-studies	07	CO3
IV	Financing & Managing Venture	Financing Stages; Sources of Finance; Venture Capital; Criteria for evaluating new-venture proposals & Capital-process. Management of venture: objectives and functions of management, scientific management, general and strategic management; introduction to human resource management: planning, job analysis, training, recruitment and selection Self-learning Topics: visit Website https://www.startupindia.gov.in	06	CO4
V	Overview of E – business	Concept of E-business, Business Success through adoption of technology, information management for business Initiatives, Performance improvement through e-business. Introduction to various collaborative partnerships, E-commerce: Sectors of e-commerce, B to C, B to B and C to C ecommerce, E-commerce success factors, clicks and Bricks in ecommerce, collaborative commerce. E-Marketplace, M-commerce, E-Government; Various E-business Models, Challenges of the E-Business Models, Globalization of E-business. Self-learning Topics: Social media applications for E-Business, Social media analytics.	08	CO5
VI	Strategic Initiatives for Technology	Customer Relationship Management: The evolution of CRM, functional areas of CRM, contemporary trends - SRM, PRM AND ERM, Future Trends of CRM Enterprise Resource Planning: Core and Extended ERP; components of ERP system; Benefits and Risks of ERP implementation Supply Chain Management: Meaning, definition, importance, and characteristics of SCM, Elements of SCM, Push & Pull supply chain model, Use of e-business to restructure supply chain, Supply chain management implementation Procurement:	08	CO6



R-2025- T.E INFORMATION TECHNOLOGY

		Meaning and advantages of e –procurement, Types& Drivers of e- procurement, Components of e- procurement systems, Implementation of e-procurement Self-learning Topics: SEM and SEO E-CRM		

Textbooks:

1. Entrepreneurship; Robert Hisrich, Michael Peters; Tata McGraw Hill Publication
2. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
3. E- Business & E– Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, Pearson Education
4. E-commerce – A Managerial Perspective- P. T. Joseph, Prentice Hall India Publications.
Content

References:

1. Entrepreneurship and Innovations in E-business An Integrative Perspective by Fang Zhao, Idea Group Publications.
2. Business Driven Technology –Haag/Baltzan/Philips –Tata McGraw Hill Publication
3. Digital Business and E-commerce Management by Dave Chaffey, David Edmundson-Bird, Tanya Hemphill, Pearson Education
4. E-Business 2.0 Roadmap for Success by Dr. Ravi Kalakota, Marcia Robinson, Pearson Education
5. Case Studies in International Entrepreneurship: Managing and Financing Ventures in the Global Economy. By Walter Kuemmerle, Walter Kuemmerle. McGraw-Hill/Irwin, 2004.
ISBN: 0072977841.

Note: - It is advisable that faculty should discuss case studies in the classroom



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC504	Software Engineering	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC504	Software Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To provide the knowledge of software engineering discipline.
2	To understand Requirements and analyze it
3	To do planning and apply scheduling
4	To apply analysis, and develop software solutions
5	To demonstrate and evaluate real time projects with respect to software engineering principles
6	Apply testing and assure quality in software solution.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand and use basic knowledge in software engineering.	L1, L2
2	Identify requirements, analyze and prepare models.	L1, L2, L3
3	Plan, schedule and track the progress of the projects.	L1, L2, L3
4	Design & develop the software solutions for the growth of society	L1, L2, L3
5	To demonstrate and evaluate real time projects with respect to software engineering principles	L1, L2, L3, L4
6	Apply testing and assure quality in software solution	L1, L2, L3, L4



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Prerequisite: Basic programming of knowledge.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	None	--	--
I	Introduction to Software Engineering	Nature of Software, Software Engineering, Software Process, Capability Maturity Model (CMM) Generic Process Model, Prescriptive Process Models: The Waterfall Model, V-model, Incremental Process Models, Evolutionary Process Models, Concurrent Models, Agile process, Agility Principles, Extreme Programming (XP), Scrum, Kanban model Self-learning Topics: Personal and Team Process Models	06	CO1,CO2
II	Requirement Analysis	Software Requirements: Functional & non-functional – user-system requirement engineering process – feasibility studies – elicitation – validation & management – software prototyping – S/W documentation – Analysis and modelling Requirement Elicitation, Software requirement specification (SRS), Self-learning Topics: prioritizing requirements (Kano diagram) - real life application case study.	07	CO1,CO2
III	Software Estimation and Scheduling	Management Spectrum, 3Ps (people, product and process) Process and Project metrics Software Project Estimation: LOC, FP, Empirical Estimation Models - COCOMO II Model, Specialized Estimation Techniques, Object based estimation, use-case based estimation Project scheduling: Defining a Task Set for the Software Project, Timeline charts, Tracking the Schedule, Earned Value Analysis Self-learning Topics: Cost Estimation Tools and Techniques, Typical Problems with IT Cost Estimates.	06	CO3



R-2025- T.E INFORMATION TECHNOLOGY

IV	Design Engineering	Design Process & quality, Design Concepts, The design Model, Pattern-based Software Design. 4.2 Architectural Design :Design Decisions, Views, Patterns, Application Architectures, Modeling Component level Design: component, Designing class based components, conducting component-level design, User Interface Design: The golden rules, Interface Design steps & Analysis, Design Evaluation Self-learning Topics: Refinement, Aspects, Refactoring	07	CO3, CO4
V	Software Risk, Configuration Management	Risk Identification, Risk Assessment, Risk Projection, RMMM Software Configuration management, SCM repositories, SCM process Software Quality Assurance Task and Plan, Metrics, Software Reliability, Formal Technical Review (FTR), Walkthrough Self-learning Topics:: Configuration management for WebApps	07	CO5
VI	Software Testing and Maintenance	Testing: Software Quality, Testing: Strategic Approach, Strategic Issues- Testing: Strategies for Conventional Software, Object oriented software, Web Apps- Validating Testing- System Testing- Art of Debugging. Maintenance : Software Maintenance-Software Supportability- Reengineering- Business Process Reengineering- Software Reengineering- Reverse Engineering- Restructuring- Forward Engineering Self-learning Topics: Test Strategies for WebApps	06	CO6

Text Books:

1. Roger S. Pressman, Software Engineering: A practitioner's approach, McGraw Hill
2. Rajib Mall, Fundamentals of Software Engineering, Prentice Hall India
3. Pankaj Jalote, An integrated approach to Software Engineering, Springer/Narosa.
4. Ian Sommerville, Software Engineering, Addison-Wesley.

References:

1. <https://nptel.ac.in/courses/106/101/106101061/>
2. <https://www.youtube.com/watch?v=wEr6mwquPLY>
3. <http://www.nptelvideos.com/video.php?id=911&c=9>
4. https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=66
5. https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=67
6. https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=65
7. https://onlinecourses.nptel.ac.in/noc19_cs70/unit?unit=25&lesson=64



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Preferable: Case studies can be discussed on every unit as per requirement for better understanding, examples are given below.

Unit 1	An information system (mental health-care system), wilderness weather system.
Unit 2	Mental health care patient management system (MHC-PMS).
Unit 3	Software Tools for Estimation.
Unit 4	Risk management in Food delivery software.
Unit 5	Study design of Biometric Authentication software.
Unit 6	Selenium Testing with any online application.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL506	IP Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract Oral /	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Tot.					
ITL506	IP Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab aims:	
1	To orient students to HTML for making webpages
2	To expose students to CSS for formatting web pages
3	To expose students to developing responsive layout
4	To expose students to JavaScript to make web pages interactive
5	To orient students to React for developing front end applications
6	To orient students to Node.js for developing backend applications

Lab Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and apply the appropriate HTML tags to develop a webpage.	L1, L2,L3,L4
2	Identify and apply the appropriate CSS tags to format data on webpage	L1, L2,L3,L4
3	Construct responsive websites using Bootstrap	L1, L2,L3,L4,L5,L6
4	Use JavaScript to develop interactive web pages.	L1, L2,L3,L4,L5,L6
5	Construct front end applications using React	L1, L2,L3,L4,L5,L6
6	Construct back end applications using Node.js/Express	L1, L2,L3,L4,L5,L6



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Prerequisite: Knowledge of Java programming and object-oriented programming.

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: Google Chrome Browser (latest), Java 8 or above, NodeJS, React. Internet Connection

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	HTML5	Elements, Attributes, Head, Body, Hyperlink, Formatting, Images, Tables, List, Frames, Forms, Multimedia	02	LO1
II	CSS3	Syntax, Inclusion, Color, Background, Fonts, Tables, lists, CSS3 selectors, Pseudo classes, Pseudo elements	02	LO2
III	Bootstrap	Grid system, Forms, Button, Navbar, Breadcrumb, Jumbotron	02	LO3
IV	JavaScript	Variables, Operators, Conditions, Loops, Functions, Events, Classes and Objects, Error handling, Validations, Arrays, String, Date	05	LO4
V	React	Installation and Configuration. JSX, Components, Props, State, Forms, Events, Routers, Refs, Keys.	08	LO5
VI	Node.js	Installation and Configuration, Callbacks, Event loops, Creating express app.	07	LO6

Textbooks:

1. HTML 5 Black Book (Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP, jQuery) 2Ed., DT Editorial Services
2. Learning React Functional Web Development with React and Redux, Alex Banks and Eve Porcello, O'Reilly
3. Learning Node.js Development, Andrew Mead, Packt Publishing

References:

1. <https://www.tutorialspoint.com/>
2. <https://reactjs.org/tutorial/tutorial.html>
3. <https://nodejs.dev/learn>
4. <https://www.youtube.com/watch?v=-27HAh8c0YU>

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL507	Security Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL507	Security Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To apply the knowledge of symmetric cryptography to implement classical ciphers.
2	To analyze and implement public key encryption algorithms, hashing and digital signature algorithms.
3	To explore the different network reconnaissance tools to gather information about networks.
4	To explore the tools like sniffers, port scanners and other related tools for analyzing.
5	To Scan the network for vulnerabilities and simulate attacks.
6	To set up intrusion detection systems using open-source technologies and to explore email security.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Illustrate symmetric cryptography by implementing classical ciphers.	L1,L2
2	Demonstrate Key management, distribution and user authentication.	L1,L2
3	Explore the different network reconnaissance tools to gather information about networks	L1,L2, L3
4	Use tools like sniffers, port scanners and other related tools for analyzing packets in a network.	L1,L2,L3
5	Use open-source tools to scan the network for vulnerabilities and simulate attacks.	L1,L2,L3
6	Demonstrate the network security system using open source tools.	L1,L2



Prerequisite: Basic concepts of Computer Networks & Network Design, Operating System

Hardware & Software Requirements:

Hardware Requirement: - PC With following Configuration - Intel Core i3/i5/i7 Processor 4 GB RAM 500 GB Harddisk	Software requirement: - Windows or Linux Desktop OS - wireshark - ARPCWATCH - Kismet, NetStumbler - NESSU

DETAILED SYLLABUS:

Sr. No.	Detailed Content	Hours	LO Mapping
I	Classical Encryption techniques (mono-alphabetic and poly-alphabetic substitution techniques: Vigenere cipher, playfair cipher)	04	LO1
II	Block cipher modes of operation using a) Data Encryption Standard b) Advanced Encryption Standard (AES). Public key cryptography: RSA algorithm. Hashing Techniques: HMAC using SHA Digital Signature Schemes – RSA, DSS.	06	LO2
III	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars. Study of packet sniffer tools Wireshark, :- a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.	04	LO3
IV	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.	04	LO4
V	Keylogger attack using a keylogger tool. Simulate DOS attack using Hping or other tools Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.	04	LO5
VI	Set up IPSec under Linux. Set up Snort and study the logs. Explore the GPG tool to implement email security	04	LO6

Text Books

1. Build your own Security Lab, Michael Gregg, Wiley India.
2. CCNA Security, Study Guide, Tim Boyles, Sybex.
3. Hands-On Information Security Lab Manual, 4th edition, Andrew Green, Michael Whitman, Herbert Mattord.
4. The Network Security Test Lab: A Step-by-Step Guide Kindle Edition, Michael Gregg.



References:

1. Network Security Bible, Eric Cole, Wiley India.
2. Network Defense and Countermeasures, William (Chuck) Easttom.
3. Principles of Information Security + Hands-on Information Security Lab Manual, 4th Ed. , Michael
a. E. Whitman , Herbert J. Mattord.
4. IITB virtual Lab: <http://cse29-iiith.vlabs.ac.in/>
5. <https://www.dcode.fr/en>

Sr.No	Experiment Title
1.	Breaking the Mono-alphabetic Substitution Cipher using Frequency analysis method.
2.	Design and Implement a product cipher using Substitution ciphers.
3.	Cryptanalysis or decoding Playfair, vigenere cipher.
4.	Encrypt long messages using various modes of operation using AES or DES.
5.	Cryptographic Hash Functions and Applications (HMAC): to understand the need, design and applications of collision resistant hash functions.
6.	Implementation and analysis of RSA cryptosystem and Digital signature scheme using RSA.
7.	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.
8.	Study of packet sniffer tools wireshark: - a. Observer performance in promiscuous as well as non-promiscuous mode. b. Show the packets can be traced based on different filters.
9.	Download, install nmap and use it with different options to scan open ports, perform OS fingerprinting, ping scan, tcp port scan, udp port scan, etc.
10.	Study of malicious software using different tools: a) Keylogger attack using a keylogger tool. b) Simulate DOS attack using Hping or other tools c) Use the NESSUS/ISO Kali Linux tool to scan the network for vulnerabilities.
11.	Study of Network security by a) Set up IPSec under Linux. b) Set up Snort and study the logs. c) Explore the GPG tool to implement email security



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL508	DevOPs Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL508	DevOPs Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand DevOps practices which aims to simplify Software Development Life Cycle
2	To be aware of different Version Control tools like GIT, CVS or Mercurial
3	To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment
4	To be familiarized with selenium tool, which is used for continuous testing of applications deployed.
5	To use Docker to Build, ship and manage applications using containerization
6	To understand the concept of Infrastructure as a code and install and configure Ansible tool.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements	L1,L2
2	To obtain complete knowledge of the “version control system” to effectively track changes augmented with Git and GitHub	L1,L2
3	To understand the importance of Jenkins to Build and deploy Software Applications on server environment	L1,L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

4	Understand the importance of Selenium and Jenkins to test Software Applications	L1,L2
5	To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker	L1,L2,L3
6	To Synthesize software configuration and provisioning using Ansible.	L1,L2,L3

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, and Software Engineering.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel i3 core or above 2. 4 GB RAM or above 3. 500 GB HDD 4. Network interface card	1. Linux / Windows Operating system 2. VIRTUAL BOX/ VMWARE	1. Internet Connection for installing additional packages 2. GitHub account 3. Docker hub account

DETAILED SYLLABUS:

Sr. No	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Knowledge of Linux Operating system, installation and configuration of services and command line basics, Basics of Computer Networks and Software Development Life cycle.	00	LO1
I	Introduction to Devops	Understanding of the process to be followed during the development of an application, from the inception of an idea to its final deployment. Learn about the concept of DevOps and the practices and principles followed to implement it in any company's software development life cycle. Learn about the phases of Software Lifecycle. Get familiar with the concept of Minimum Viable Product (MVP) & Cross-functional Teams. Understand why DevOps evolved as a prominent culture in most of the modern-day startups to achieve agility in the software development process Self-Learning Topics: Scrum, Kanban, Agile	04	LO1



R-2025- T.E INFORMATION TECHNOLOGY

II	Version Control	In this module you will learn: ● GIT Installation, Version Control, Working with remote repository ● GIT Cheat sheet ● Create and fork repositories in GitHub ● Apply branching, merging and rebasing concepts. ● Implement different Git workflow strategies in real-time scenarios ● Understand Git operations in IDE Self-Learning Topics: AWS Codecommit, Mercurial, Subversion, Bitbucket, CVS	04	LO1 & LO2
III	Continuous Integration using Jenkins	In this module, you will know how to perform Continuous Integration using Jenkins by building and automating test cases using Maven / Gradle / Ant. ● Introduction to Jenkins (With Architecture) ● Introduction to Maven / Gradle / Ant. ● Jenkins Management Adding a slave node to Jenkins ● Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to deploy an application over the tomcat server ● Self-Learning Topics: Travis CI, Bamboo, GitLab, AWS CodePipeline	04	LO1 & LO3
IV	Continuous Testing with Selenium	In this module, you will learn about selenium and how to automate your test cases for testing web elements. You will also get introduced to X-Path, TestNG and integrate Selenium with Jenkins and Maven. ● Introduction to Selenium ● Installing Selenium ● Creating Test Cases in Selenium WebDriver ● Run Selenium Tests in Jenkins Using Maven Self-Learning Topics: Junit, Cucumber	04	LO1, LO3 & LO4
V	Continuous Deployment: Containerization with Docker	In this module, you will be introduced to the core concepts and technology behind Docker. Learn in detail about container and various operations performed on it. ● Introduction to Docker Architecture and Container Life Cycle ● Understanding images and containers ● Create and Implement docker images using Dockerfile. ● Container Lifecycle and working with containers. ● To Build, deploy and manage web or software application on Docker Engine. ● Publishing image on Docker Hub.	05	LO1 & LO5



R-2025- T.E INFORMATION TECHNOLOGY

		Self-Learning Topics: Docker Compose, Docker Swarm.		
VI	Continuous Deployment: Configuration Management with Puppet	In this module, you will learn to Build and operate a scalable automation system. ● Puppet Architecture ● Puppet Master Slave Communication ● Puppet Blocks ● Installation and Configuring Puppet Master and Agent on Linux machines ● Use exported resources and forge modules to set up Puppet modules ● Create efficient manifests to streamline your deployments Self-Learning Topics: Ansible, Saltstack	05	LO1 & LO6

Text books

1. DevOps Bootcamp, Sybgen Learning
2. Karl Matthias & Sean P. Kane, Docker: Up and Running, O'Reilly Publication.
3. Len Bass, Ingo Weber, Liming Zhu, "DevOps, A Software Architects Perspective", AddisonWesley-Pearson Publication.
4. John Ferguson Smart, "Jenkins, The Definitive Guide", O'Reilly Publication.
5. Mastering Puppet 5: Optimize enterprise-grade environment performance with Puppet, by Ryan Russell-
Yates Packt Publishing (September 29, 2018)

References:

1. Sanjeev Sharma and Bernie Coyne, "DevOps for Dummies", Wiley Publication
2. Httermann, Michael, "DevOps for Developers", Apress Publication.
3. Joakim Verona, "Practical DevOps", Pack publication
4. Puppet 5 Essentials - Third Edition: A fast-paced guide to automating your infrastructure by Martin Alfke Packt Publishing; 3rd Revised edition (September 13, 2017)



List of Experiments:

Sr.No	Experiment Title
1.	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
2.	To understand Version Control System / Source Code Management, install git and create a GitHub account.
3.	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet
4.	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
5.	To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
6.	To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
7.	To Setup and Run Selenium Tests in Jenkins Using Maven.
8.	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
9.	To learn Dockerfile instructions, build an image for a sample web application using Dockerfile.
10.	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
11.	To learn Software Configuration Management and provisioning using Puppet Blocks(Manifest, Modules, Classes, Function)
12	To provision a LAMP/MEAN Stack using Puppet Manifest.

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments, one of which must include a Case study on DevOps Implementation in real world and the other one can be based on the self-learning topics mentioned in syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL509	Advance DevOps Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL509	Advance DevOps Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To understand DevOps practices and cloud native environments to achieve continuous software delivery pipelines and automated operations that address the gap between IT resources and growing cloud complexity.
2	To Use Kubernetes services to structure N-tier applications.
3	To be familiarized with Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service.
4	To understand that security and speed in software development are not inversely-related objectives Internalizing the contribution of tools and automation in DevSecOps
5	To understand various troubleshooting techniques by monitoring your entire infrastructure and business processes
6	To understand how software and software-defined hardware are provisioned dynamically.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	To understand the fundamentals of Cloud Computing and be fully proficient with Cloud based DevOps solution deployment options to meet your business requirements	L1,L2
2	To deploy single and multiple container applications and manage application deployments with rollouts in Kubernetes	L1,L2,L3
3	To apply best practices for managing infrastructure as code environments and use terraform to define and deploy cloud	L1,L2,L3



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

	infrastructure.	
4	To identify and remediate application vulnerabilities earlier and help integrate security in the development process using SAST Techniques.	L1,L2,L3
5	To use Continuous Monitoring Tools to resolve any system errors (low memory, unreachable server etc.) before they have any negative impact on the business productivity	L1,L2,L3
6	To engineer a composition of nano services using AWS Lambda and Step Functions with the Serverless Framework	L1,L2,L3

Prerequisite: Operating System, Linux Administration, Java /Web Application Programming, Software Engineering, Cloud Computing and DevOps Ecosystem.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements	Other Requirements
PC With following Configuration 1. Intel i3 core or above 2. 4 GB RAM or above 3. 500 GB HDD 4. Network interface card	1. Linux / Windows Operating system 2. VIRTUAL BOX/ VMWARE	1. Internet Connection for installing additional packages 2. GitHub account 3. AWS free tier account

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hour s	LO Mapping
0	Prerequisite	Knowledge of Linux Operating system, installation and configuration of services and command line basics, Basics of Computer Networks, Software Development Life cycle, Cloud Computing and DevOps Ecosystem.	02	--
I	Introduction to Devops on Cloud	Learn about various cloud services and service providers, also get the brief idea of how to implement DevOps over Cloud Platforms. Introduction to high availability architecture and auto-scaling Set up the DevOps infrastructure on the cloud Work and set up IDE on Cloud9 Deploy projects on AWS using Code Build, CodeDeploy, and CodePipeline Self-Learning Topics: AWS Codestar	04	LO1



R-2025- T.E INFORMATION TECHNOLOGY

II	Container Orchestration using Kubernetes	In this module, you will learn how Kubernetes automates many of the manual processes involved in deploying, managing, and scaling containerized applications. Install and configure Kubernetes Spin Up a Kubernetes Cluster Check the Nodes of Your Kubernetes Cluster Installing kubectl to manage cluster and deploy Your First Kubernetes Application Self-Learning Topics: Using Services and Ingresses to Expose Deployments Perform logging, monitoring, services, and volumes in Kubernetes	04	LO1, LO2
III	Infrastructure Automation with Terraform	In this module you will learn, Infrastructure as code for provisioning, compliance, and management of any cloud infrastructure, and service. Introduction to Infrastructure as Code with Terraform Install, Build, change and Destroy Infrastructure using Terraform. Self-Learning Topics: Terraform Create Resource Dependencies Provision Infrastructure Define Input Variables, Query Data with output and store remote state	04	LO1, LO3
IV	DevSecOps: Static Application Security Testing (SAST)	In this module, you will learn to identify and remediate application vulnerabilities earlier and help integrate security in the development process using tools like SonarQube / Gitlab / Perform static analysis on application source code and binaries. Spot potential vulnerabilities before deployment Analysis of java / web-based project Jenkins SonarQube / Gitlab Integration Self-Learning Topics: Snyk, OWASP ZAP, Analysis Core Plugin	04	LO1, LO4
V	DevSecOps: Continuous Monitoring	In this module, you will learn to detect, report, respond to the attacks and issues which occur within the infrastructure. Introduction to Continuous Monitoring Introduction to Nagios Installing Nagios Nagios Plugins (NRPE) and Objects Nagios Commands and Notification Monitoring of different servers using Nagios Self-Learning Topics: Splunk, Snort, Tenable	04	LO1, LO5



R-2025- T.E INFORMATION TECHNOLOGY

VI	NoOps: Serverless Computing	In this module, you will learn serverless computing platform like AWS Lambda, which allows you to build your code and deploy it without ever needing to configure or manage underlying servers. AWS Lambda - Overview and Environment Setup Building and Configuring the Lambda function (NODEJS/PYTHON/JAVA) Creating & Deploying using AWS Console/CLI Creating & Deploying using Serverless Framework Self-Learning Topics: AWS Lambda Create a REST API with the Serverless Framework	04	LO1, LO6

Textbooks:

1. AWS Certified SysOps Administrator Official Study Guide: Associate Exam by Stephen Cole (Author), Gareth Digby (Author), Chris Fitch (Author), Steve Friedberg (Author), Shaun Qual
2. AWS Certified Solutions Architect Official Study Guide: Associate Exam by Joe Baron
3. Terraform: Up & Running - Writing Infrastructure as Code, Second Edition by Yevgeniy Brikman , O'Reilly
4. Kubernetes: Up and Running - Dive into the Future of Infrastructure, Second Edition by Brendan Burns, O'Reilly
5. Going Serverless with AWS Lambda: Leveraging the latest services from the AWS cloud by Ajay Pherwani , Shroff/X-Team;
6. Learning Nagios, Packt Publishing.

References:

1. Learning Aws - Second Edition: Design, build, and deploy responsive applications using AWS by Amit Shah Aurobindo Sarkar
2. Mastering Aws Lambda by Yohan Wadia Udit Gupta

List of Experiments:

Sr. No	Experiment Title
1	To understand the benefits of Cloud Infrastructure and Setup AWS Cloud9 IDE, Launch AWS Cloud9 IDE and Perform Collaboration Demonstration.
2	To Build Your Application using AWS CodeBuild and Deploy on S3 / SEBS using AWS CodePipeline, deploy Sample Application on EC2 instance using AWS CodeDeploy.
3	To understand the Kubernetes Cluster Architecture, install and Spin Up a Kubernetes Cluster on Linux Machines/Cloud Platforms.
4	To install Kubectl and execute Kubectl commands to manage the Kubernetes cluster and deploy Your First Kubernetes Application.
5	To understand terraform lifecycle, core concepts/terminologies and install it on a Linux Machine.



R-2025- T.E INFORMATION TECHNOLOGY

6	To Build, change, and destroy AWS / GCP /Microsoft Azure/ DigitalOcean infrastructure Using Terraform.
7	To understand Static Analysis SAST process and learn to integrate Jenkins SAST to SonarQube/GitLab.
8	Create a Jenkins CI/CD Pipeline with SonarQube / GitLab Integration to perform a static analysis of the code to detect bugs, code smells, and security vulnerabilities on a sample Web / Java / Python application.
9	To Understand Continuous monitoring and Installation and configuration of Nagios Core, Nagios Plugins and NRPE (Nagios Remote Plugin Executor) on Linux Machine.
10	To perform Port, Service monitoring, Windows/Linux server monitoring using Nagios.
11	To understand AWS Lambda, its workflow, various functions and create your first Lambda functions using Python / Java / Nodejs.
12	To create a Lambda function which will log “An Image has been added” once you add an object to a specific bucket in S3.

Term Work: Term Work shall consist of at least 12 to 15 practicals based on the above list. Also Term work Journal must include at least 2 assignments based on the self-learning topics mentioned in syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching scheme			Credit assigned			
		Theor y	Pract.	Tut.	Theor y	Pract.	Tut.	Total
ITL510	Professional Communication & Ethics-II (PCE-II)	--	2*+ 2 Hours (Batch-wise)	--	--	02	--	02

***Theory class to be conducted for full class.**

Course Code	Course Name	Examination Scheme									
		Theory					Term work	Pract	Oral	Internal Oral	Total
		Internal Assessment			End sem	Duration (hrs)					
		IAT 1	IAT 2	Total							
ITL510	Professional Communication & Ethics-II (PCE-II)	--	--	--	--	--	25	--	--	25	50

Course Code	Course Name	Credits
	Professional Communication & Ethics-II (PCE-II)	02
Course Rationale	This curriculum is designed to build up a professional and ethical approach, effective oral and written communication with enhanced soft skills. Through practical sessions, it augments student's interactive competence and confidence to respond appropriately and creatively to the implied challenges of the global Industrial and Corporate requirements. It further inculcates the social responsibility of engineers as technical citizens.	
Course Objectives	- To discern and develop an effective style of writing important technical/business documents. - To investigate possible resources and plan a successful job campaign. - To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement. - To develop creative and impactful presentation skills. - To analyze personal traits, interests, values, aptitudes and skills. - To understand the importance of integrity and develop a personal code of ethics.	
Course Outcomes	Learner will be able to... - plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles. - strategize their personal and professional skills to build a professional image and meet the demands of the industry. - emerge successful in group discussions, meetings and result-oriented agreeable solutions in	



R-2025- T.E INFORMATION TECHNOLOGY

	group communication situations. • deliver persuasive and professional presentations. • develop creative thinking and interpersonal skills required for effective professional communication. • apply codes of ethical conduct, personal integrity and norms of organizational behaviour.

Module	Contents	Hours
1	ADVANCED TECHNICAL WRITING :PROJECT/PROBLEM BASED LEARNING (PBL) 1.1 Purpose and Classification of Reports: Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.) Time Interval (Periodic, One-time, Special) Function (Informational, Analytical, etc.) Physical Factors (Memorandum, Letter, Short & Long) 1.2 Parts of a Long Formal Report: Prefatory Parts (Front Matter) Report Proper (Main Body) Appended Parts (Back Matter) 1.3 Language and Style of Reports Tense, Person & Voice of Reports Numbering Style of Chapters, Sections, Figures, Tables and Equations Referencing Styles in APA & MLA Format Proofreading through Plagiarism Checkers 1.4. Definition, Purpose & Types of Proposals Solicited (in conformance with RFP) & Unsolicited Proposals Types (Short and Long proposals) 1.5. Parts of a Proposal Elements Scope and Limitations Conclusion 1.6. Technical Paper Writing Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References) Language and Formatting Referencing in IEEE Format	06



R-2025- T.E INFORMATION TECHNOLOGY

2	EMPLOYMENT SKILLS 2.1 Cover Letter & Resume Parts and Content of a Cover Letter Difference between Bio-data, Resume & CV Essential Parts of a Resume Types of Resume (Chronological, Functional & Combination) 2.2 Statement of Purpose Importance of SOP Tips for Writing an Effective SOP 2.3 Verbal Aptitude Test Modelled on CAT, GRE, GMAT exams 2.4. Group Discussions Purpose of a GD Parameters of Evaluating a GD Types of GDs (Normal, Case-based & Role Plays) GD Etiquettes 2.5. Personal Interviews Planning and Preparation Types of Questions Types of Interviews (Structured, Stress, Behavioural, Problem Solving & Case-based) Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual	06
3	BUSINESS MEETINGS 3.1 Conducting Business Meetings Types of Meetings Roles and Responsibilities of Chairperson, Secretary and Members Meeting Etiquette 3.2. Documentation Notice Agenda Minutes	02
4	TECHNICAL/ BUSINESS PRESENTATIONS 4.1 Effective Presentation Strategies Defining Purpose Analyzing Audience, Location and Event Gathering, Selecting & Arranging Material Structuring a Presentation Making Effective Slides Types of Presentations Aids Closing a Presentation Platform skills 4.2 Group Presentations Sharing Responsibility in a Team Building the contents and visuals together Transition Phases	02



R-2025- T.E INFORMATION TECHNOLOGY

5	INTERPERSONAL SKILLS 5.1 Interpersonal Skills Emotional Intelligence Leadership & Motivation Conflict Management & Negotiation Time Management Assertiveness Decision Making 5.2 Start-up Skills Financial Literacy Risk Assessment Data Analysis (e.g. Consumer Behaviour, Market Trends, etc.)	08
6	CORPORATE ETHICS 6.1 Intellectual Property Rights Copyrights Trademarks Patents Industrial Designs Geographical Indications Integrated Circuits Trade Secrets (Undisclosed Information) 6.2 Case Studies Cases related to Business/ Corporate Ethics	02

List of assignments:

(In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analyzing a Published Technical Paper
5. Writing a SOP
6. IPR
7. Interpersonal Skills
8. Aptitude test (Verbal Ability)

Note:

1. The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
2. The group size for the final report presentation should not be less than 5 students or exceed 7 students.
3. There will be an end-semester presentation based on the book report.



Assessment:

Term Work:

Term work shall consist of minimum 8 experiments.

The distribution of marks for term work shall be as follows:

Assignment : 10 Marks

Attendance : 5 Marks

Presentation slides : 5 Marks

Book Report (hard copy) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of laboratory work and minimum passing in the term work.

Internal oral:

Oral Examination will be based on a GD & the Project/Book Report presentation.

Group Discussion: 10 marks

Project Presentation : 10 Marks

Group Dynamics: 5 Marks

Books Recommended:

Textbooks and Reference books:

1. Arms, V. M. (2005). *Humanities for the engineering curriculum: With selected chapters from Olsen/Huckin: Technical writing and professional communication, second edition*. Boston, MA: McGraw- Hill.
2. Bovée, C. L., & Thill, J. V. (2021). *Business communication today*. Upper Saddle River, NJ: Pearson.
3. Butterfield, J. (2017). *Verbal communication: Soft skills for a digital workplace*. Boston, MA: Cengage Learning.
4. Masters, L. A., Wallace, H. R., & Harwood, L. (2011). *Personal development for life and work*. Mason: South-Western Cengage Learning.
Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). *Organizational behaviour*. Harlow, England: Pearson.
5. Meenakshi Raman, Sangeeta Sharma (2004) *Technical Communication, Principles and Practice*. Oxford University Press
6. Archana Ram (2018) *Place Mentor, Tests of Aptitude For Placement Readiness*. Oxford University Press
Sanjay Kumar & PushpLata (2018). *Communication Skills a workbook*, New Delhi: Oxford University Press.



R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL511	Mini Project – 2 A Web Based Business Model	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ITL511	Mini Project – 2 A Web Based Business Model	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement



R-2025- T.E INFORMATION TECHNOLOGY

for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.

- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book: 10
 - Marks awarded by review committee: 10
 - Quality of Project report: 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building



R-2025- T.E INFORMATION TECHNOLOGY

of working prototype, testing and validation of results based on work completed in an earlier semester.

- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Mini Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC551	Microcontroller Embedded Programming	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC551	Microcontroller Embedded Programming	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Conceptualize the architecture of embedded systems.
2	Study the basics of microcontroller 8051.
3	Elaborate on the concepts of microcontroller interfacing.
4	Understand the concepts of ARM architecture
5	Study the concepts of real-time operating system
6	Learn about various embedded platforms and their programming

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Introduce and discuss the embedded system concepts, architecture of embedded systems and understand the embedded development environments	L1, L2
2	Describe the architecture of 8051 microcontroller and write embedded programs for 8051Microcontroller	L2, L3



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

3	Illustrate the interfacing of peripherals with 8051 microcontroller and write programs	L2, L3
4	Understand and apply the concepts of ARM architecture	L2, L3
5	Explain and Demonstrate the open source RTOS	L3
6	Select the embedded platform and program it for real time application	L3, L4

Prerequisite: Computer Organization and Architecture, Operating System.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Revision of microcomputer system terminologies, High level, difference between microprocessor and microcontroller, basics of operating System.	02	--
I	Introduction to Embedded systems	Overview of Embedded System Architecture, Application areas, Categories of embedded systems, specialties of embedded systems. Recent trends in embedded systems. Brief introduction to embedded microcontroller cores CISC, RISC, ARM, DSP and SoC. Introduction to Embedded System Integrated Development Environments (IDEs) with examples. Self-learning Topics: Comparison of CISC & RISC, Case studies of Real Time Embedded Systems.	04	CO1
II	The Microcontroller Architecture and Programming of 8051	Introduction to 8051 Microcontroller, Architecture, Pin configuration, Memory Organization, Input /Output Ports, Counter and Timers, Serial communication, Interrupts. Addressing modes, Instruction set 8051 developing tools, Programming based on Arithmetic & Logical Operations, I/O parallel and serial ports, Timers & Counters, and ISR. Self-learning Topics: Writing 8051 programming in Embedded C	10	CO2



R-2025- T.E INFORMATION TECHNOLOGY

III	Interfacing with 8051 Microcontroller	Interfacing 8051 with peripherals: ADC, DAC, stepper motor. Interfacing 8051 with LED, LCD, keyboard, Temp sensor, etc. using assembly language. Self-learning Topics: Study of 8051 based GSM, Bluetooth and RS232 communication	04	CO3
IV	ARM 7 Architecture	Architectural inheritance, Detailed study of Programmer's model, ARM Development tools, Addressing modes, Instruction set: Data processing, Data Transfer, Control flow. Pipelining, Writing simple assembly language programs. Brief introduction to exceptions and interrupts handling. Self-learning Topics: Writing ARM programs in Embedded C and Python for sensor application	07	CO4
V	Open source RTOS Real Time system concept with embedded OS	Basics of RTOS: Real-time concepts, Hard Real time and Soft Real-time, differences between general purpose OS & RTOS, Basic architecture of an RTOS, scheduling systems, Inter-process-communication using pipes and mailboxes, performance matrix in scheduling models, interrupt management in RTOS environment, RTOS comparative study. ucos2 for real time embedded system demonstrate one case study: Case study of automobile RTOS issues in multitasking –selecting a Real Time Operating System Self-learning Topics: Inter-process-communication using semaphore, and Mutex, RTOS simple programming using ucos2	07	CO5
VI	Introduction to Embedded Platforms	Overview of various Embedded hardware Platforms: Architecture of Arduino, Basic Arduino programming using Arduino IDE and Arduino libraries for interfacing of LCD and sensors such as Temperature (DHT11), Pressure, Humidity. RaspberryPi (RPi-Functional Block diagram and its operation, GPIO pins, Features of RaspbianOS)	05	CO6



R-2025- T.E INFORMATION TECHNOLOGY

		Programming Arduino using python (pyserial or pyfirmata): blink.py Programming RaspberryPi GPIO using python: blink.py Self-learning Topics: Study of Arduino/ RaspberryPi using Thingspeak cloud platform and Blink app using Mobile.		

Textbooks:

1. M. A. Mazidi, J. G. Mazidi, R. D., McKinlay, "The 8051 microcontroller & Embedded systems Using Assembly and C", Pearson, 3rd edition
2. Embedded / real – time systems: concepts, design & programming, Black Book, Dr. K. V.
a. K. K. Prasad, Dreamtech press, Reprint edition 2013

References:

1. Steve Furber, "ARM System on chip Architecture", Pearson, edition second
2. Laya B. Das, "Embedded systems an integrated approach", Pearson, Third impression, 2013
3. Embedded Systems, Architecture, program and Design by Rajkamal
4. Simon Monk, "Raspberry Pi Cookbook", O'reilly
5. Massimo Banzì, "Getting Started with Arduino: The Open Source Electronics Prototyping Platform (Make)", O'Reilly Media.
6. <https://nptel.ac.in/courses/117/104/117104072/>
7. <https://www.coursera.org/learn/raspberry-pi-platform>



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC552	Advance Data Management Technologies	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC552	Advance Data Management Technologies	20	20	20	80	3	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To impart knowledge related to query processing and query optimization phases of a database management system.
2	To learn advanced techniques for data management and to overview emerging data models like Temporal, Mobile, and Spatial database.
3	To introduce advanced database models like distributed databases.
4	To create awareness of how enterprise can organize and analyze large amounts of data by creating a Data Warehouse.
5	To understand the process of data extraction, transformation and loading.
6	To understand the concept of Big data and NoSQL databases..



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Outcomes:

Sr. No.	Course Outcomes:	Cognitive levels of attainment as per bloom's Taxonomy
1	Measure query costs and design alternate efficient paths for query execution.	L1,L2
2	Apply sophisticated access protocols to control access to the database.	L1,L2,L3
3	Implement Distributed databases.	L1,L2,L3
4	Organize strategic data in an enterprise and build a data Warehouse.	L1,L2,L3
5	Analyse data using OLAP operations so as to take strategic decisions.	L1,L2,L3,L4
6	Design modern applications using NoSQL databases.	L1,L2,L3,L4

Prerequisite: Course on Database Management System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Reviewing basic concepts of a Relational database, SQL concepts	02	----
I	Query Processing and Optimization	Overview: Introduction, Query processing in DBMS, Steps of Query Processing, Measures of Query Cost Selection Operation, Sorting, Join Operation, Evaluation of Expressions. Query Optimization Overview, Goals of Query Optimization, Approaches of Query Optimization, Transformations of Relational Expression, Estimating Statistics of Expression Results Choice of Evaluation Plans. Self-learning Topics: Solve problems on query optimization.	06	CO1



R-2025- T.E INFORMATION TECHNOLOGY

II	Advanced Data Management Techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges. Mandatory Access Control and Role- Based Access Control, Remote Database access protocol. Overview of Advanced Database Models like Mobile databases, Temporal databases, Spatial databases. Self-learning Topics: Learn Data Security concepts like Authentication, Authorization and encryption.	06	CO2
III	Distributed Databases	Introduction: Distributed Data Processing, Distributed Database System: Architecture, Types, Design Issues. Data Fragmentation, Allocation in distributed databases. Self-learning Topics: Query Optimization in Distributed Databases	04	CO3
IV	Data Warehousing, Dimensional Modelling and OLAP	The Need for Data Warehousing; Data Warehouse Defined; Is data warehouse still relevant in the age of big data, Features of a Data Warehouse; Data Warehouse Architecture-Enterprise or centralized, federated and multi tiered architectures; Data Warehouse and Data Marts; Data Warehousing Design Strategies, Data modeling- Dimensional Model; The Star Schema; How Does a Query Execute? The Snowflake Schema; Fact Tables and Dimension Tables; Factless Fact Table;; Updates To Dimension Tables, Primary Keys, Surrogate Keys & Foreign Keys. What is business intelligence, use of BI, Tools used in BI, Need for Online Analytical Processing; OLAP Operations in a cube: Roll-up, Drill-down, Slice, Dice, Pivot; OLAP Architectures: MOLAP, ROLAP, DOLAP and HOLAP. Self-learning Topics: Explore life cycle of data warehouse development	09	CO4
V	ETL Process	Challenges in ETL Functions; Data Extraction; Identification of Data Sources; Immediate Data Extraction, Deferred Data Extraction; Data Transformation: Tasks Involved in Data Transformation, Techniques of Data Loading Self-learning Topics: Find out various ETL tools for enterprise data management.	05	CO5



R-2025- T.E INFORMATION TECHNOLOGY

VI	Big data and NoSQL	Big data and NoSQL : Introduction, types and characteristics of big data, What is NoSQL, CAP theorem, BASE property, NoSQL data architecture patterns: Key-value stores, Graph stores, Column family stores, Document stores. Self-learning Topics: Google's Bigtable, Cassandra, MongoDB, Neo4j	07	CO6

Textbooks:

1. Korth, Slberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Theraja Reema, "Data Warehousing", Oxford University Press.
4. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Edition - McGraw Hill

References:

1. Paulraj Ponniah, "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Ralph Kimball, Margy Ross, "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition. Wiley India.
3. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.
4. Peter Rob and Carlos Coronel, "Database Systems Design, Implementation and Management", Thomson Learning, 9th Edition.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC553	Computer Graphics & Multimedia System	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC553	Computer Graphics & Multimedia System	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To equip student with the fundamental knowledge and basic technical competence in the field of Computer Graphics.
2	To emphasize on understanding of Computer Graphics Algorithms.
3	To prepare the student for advanced areas in the field of Computer Graphics.
4	To introduce student for professional avenues in the field of Computer Graphics
5	To introduce students about basic fundamentals and key aspects of Multimedia system.
6	To equip the students for various techniques of Multimedia.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Describe the basic concepts of Computer Graphics.	L1,L2
2	Demonstrate various algorithms for basic graphics primitives.	L1,L2



R-2025- T.E INFORMATION TECHNOLOGY

3	Apply 2-D geometric transformations on graphical objects. Use various Clipping algorithms on graphical objects	L1,L2,L3
4	Explore 3-D geometric transformations and curve representation techniques.	L1,L2,L3
5	Describe the basics of Multimedia System	L1,L2
6	Explore the Digital images audio & video and their related concepts.	L1,L2,L3

Prerequisite: Basic knowledge of mathematics.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of mathematics	--	---
I	Introduction	Definition and Representative uses of computer graphics, Overview of coordinate system, Definition of scan conversion, Raster scan & random scan displays, Architecture of raster graphics system with display processor, Architecture of random scan systems. Self-learning Topics:- study the working of some Raster scan display devices	02	CO1
II	Output Primitives	Scan conversions of point, line and circle: DDA algorithm and Bresenham algorithm for line drawing, Midpoint algorithm for circle, Aliasing, Antialiasing techniques like Pre filtering and post filtering, super sampling, and pixel phasing. Filled Area Primitive: Scan line Polygon Fill algorithm, inside outside tests, Boundary Fill and Flood fill algorithm. Self-learning Topics:-Implementation of DDA and Bresenham's line algorithm for dotted line, dashed line, Dash-dot line etc.	08	CO2
III	Two Dimensional Transformations and Clipping	Basic 2D transformations:- Translation, Scaling, Rotation, Reflection. Matrix representation and Homogeneous Coordinates. Composite transformation. Viewing transformation pipeline and Window to Viewport coordinate transformation. Clipping operations: Point clipping, Line Clipping. Line clipping algorithms: Cohen- Sutherland, Liang-Barsky, Polygon Clipping Algorithms: Sutherland- Hodgeman, Weiler-Atherton.	09	CO3



R-2025- T.E INFORMATION TECHNOLOGY

		Self-learning Topics:-Implementation of 2D transformations like translation, rotation and scaling. Implementation of clipping algorithm.		
IV	3D Transformation, curves and fractals	3D Transformations: Translation, Rotation, Scaling. Reflection , Composite transformations: Rotation about an arbitrary axis. Bezier Curve, B-Spline Curve. Fractal-Geometry: Fractal Dimension, Hilbert's curve, Koch Curve. Self-learning Topics:-Implementation of 3D transformations, Bezier curve , Koch curve.	06	CO4
V	Introduction to Multimedia	Overview, Objects and Elements of Multimedia, Applications of Multimedia, Multimedia Systems Architecture – IMA, Workstation, Network, Types of Medium (Perception, Representation-..), Interaction Techniques Self-learning Topics:-Study the objects and elements of multimedia	04	CO5
VI	Digital Image, audio & video	Digital Image Representation (2D format, resolution) Types of Images (monochrome, gray, color), File formats: JPG. Compression Techniques: fundamentals (coding, inter pixel and psychovisual redundancies). Types – lossless and lossy Compression, Lossless Compression Algorithms– Shannon-Fano, Lossy Compression Algorithm – JPEG Digital Audio Basic Sound Concepts: computer representation of sound File Formats – WAV Digital Video Digitization of Video, types of video signals (component, composite and S-video). File Formats: MPEG Video Self-learning Topics:-Implementation of compression algorithms, Analysis of Digital audio and digital video file formats.	10	CO6

Text Books:

1. Hearn & Baker, “Computer Graphics C version”, 2nd Edition, Pearson Publication.
2. James D. Foley, Andries van Dam, Steven K Feiner, John F. Hughes, “Computer Graphics Principles and Practice in C”, 2nd Edition, Pearson Publication



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

3. Rajesh K. Maurya, "Computer Graphics", Wiley India Publication.
4. Multimedia System Design, Prabhat K. Andleigh & Kiran Thakrar, PHI
5. Fundamentals of Multimedia, Ze-Nian Li & Mark S. Drew, PHI.

References:

1. D. Rogers, "Procedural Elements for Computer Graphics", Tata McGraw-Hill Publications.
2. Samit Bhattacharya, "Computer Graphics", Oxford Publication
3. Multimedia Communication Systems: Techniques, Standards & Networks, K. R. Rao, Zoran S. Bojkovic & Dragorad A. Milovanovic, TMH.
4. Multimedia Systems, K. Buford, PHI.

Sr.No	Online Resources
1	https://nptel.ac.in/courses/106/106/106106090/
2	https://nptel.ac.in/courses/106/103/106103224/
3	https://nptel.ac.in/courses/106/102/106102065/
4	https://onlinecourses.swayam2.ac.in/nou21_cs04/preview
5	https://nptel.ac.in/courses/117/105/117105083/

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC554	Advanced Data structure and Analysis	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC554	Advanced Data Structure and Analysis	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To learn mathematical background for analysis of algorithm
2	To learn various advanced data structures.
3	To understand the different design approaches of algorithm.
4	To learn dynamic programming methods.
5	To understand the concept of pattern matching
6	To learn advanced algorithms.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the different methods for analysis of algorithms.	L1,L2
2	Choose an appropriate advanced data structure to solve a specific problem.	L1,L2
3	Apply an appropriate algorithmic design approach for a given problem.	L1,L2,L3
4	Apply the dynamic programming technique to solve a given problem.	L1,L2,L3
5	Select an appropriate pattern matching algorithm for a given application.	L1,L2,L3
6	Understand the concepts of Optimization, Approximation and Parallel computing algorithms.	L1,L2



Prerequisite: Data structures and Analysis, Knowledge of Any Programming Language

DETAILED SYLLABUS:

Sr. No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of Data structures and analysis and programming language.	02	-
I	Introduction	Fundamentals of the analysis of algorithms: Time and Space complexity, Asymptotic analysis and notation, average and worst-case analysis, Recurrences: The substitution method, Recursive tree method, Masters method. Self-learning Topics: Analysis of Time and space complexity of iterative and recursive algorithms	04	CO1
II	Advanced Data Structures	B/B+ tree, Red-Black Trees, Heap operations, Implementation of priority queue using heap, Topological Sort. Self-learning Topics: Implementation of Red-Black Tree and Heaps.	05	CO2
III	Divide and Conquer AND Greedy algorithms	Introduction to Divide and conquer, Analysis of Binary Search, Merge sort and Quick sort, Finding minimum and maximum algorithm. Introduction to Greedy Algorithms: Knapsack Problem, Job sequencing using deadlines, Optimal storage on tape, Optimal Merge Pattern, Analysis of all these algorithms and problem solving. Self-learning Topics: Implementation of minimum and maximum algorithm, Knapsack problem, Job sequencing using deadlines.	08	CO3
IV	Dynamic algorithms	Introduction to Dynamic Algorithms, all pair shortest path, 0/1 knapsack, travelling salesman problem, Matrix Chain Multiplication, Optimal binary search tree, Analysis of All algorithms and problem solving. Self-learning Topics: Implementation of All pair shortest path, 0/1 Knapsack and OBST.	06	CO4



R-2025- T.E INFORMATION TECHNOLOGY

V	String Matching	Introduction, the naïve string matching algorithm, Rabin Karp algorithm, Boyer Moore algorithm, Knuth- Morris-Pratt algorithm, Longest Common Subsequence (LCS), Analysis of All algorithms and problem solving. Self-learning Topics: Implementation of Robin Karp algorithm, KMP algorithm and LCS.	07	CO5
VI	Advanced Algorithms and NP problems	Optimization Algorithms: Genetic algorithm(GA), Approximation Algorithms: Vertex-cover problem, Parallel Computing Algorithms: Fast Fourier Transform, Introduction to NP-Hard and NP-Complete Problems Self-learning Topics: Implementation of Genetic algorithm and Vertex-cover problem	07	CO6

Textbooks:

1. Introduction to Algorithms, Cormen, Leiserson, Rivest, Stein, PHI.
2. Algorithms: Design and Analysis, Harsh Bhasin, OXFORD.
3. Fundamentals of Computer Algorithms, Horowitz, Sahani, Rajsekaran, Universities Press.
4. C and Data structures, Deshpande, Kakde, Dreamtech Press.

References:

1. Data Structures and Algorithms in C++, Goodrich, Tamassia, Mount, WILEY.
2. Data Structures using C, Reema Thareja , OXFORD.
3. Data Structures and Algorithm Analysis in C, Mark A. Weiss, Pearson.
4. Optimization Algorithms and Applications, By Rajesh Kumar Arora by Chapman and Hall



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Online Resources

Sr.No	Website Links
<u>1</u>	https://nptel.ac.in/courses/106/106/106106131/
<u>2</u>	https://swayam.gov.in/nd1_noc19_cs47/preview
<u>3</u>	https://www.coursera.org/specializations/algorithms
<u>4</u>	https://www.mooc-list.com/tags/algorithms

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com

T.E Syllabus

SEM 6



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC601	Data Mining & Business Intelligence	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC601	Data Mining & Business Intelligence	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To introduce the concept of data warehouse & data Mining as an important tool for enterprise data management and as a cutting-edge technology for building competitive advantage.
2	To enable students to effectively identify sources of data and process it for data mining.
3	To make students well versed in all data mining algorithms, methods of evaluation.
4	To impart knowledge of tools used for data mining
5	To provide knowledge on how to gather and analyze large sets of data to gain useful business understanding.
6	To impart skills that can enable students to approach business problems analytically identifying opportunities to derive business value from data.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Demonstrate an understanding of the importance of data warehousing and data mining and the principles of business intelligence.	L1
2	Organize and prepare the data needed for data mining using pre preprocessing techniques.	L1,L2,L3
3	Perform exploratory analysis of the data to be used for mining.	L1,L2,L3,L4
4	Implement the appropriate data mining methods like classification, clustering or Frequent Pattern mining on large data sets.	L1,L2,L3,L4,L5
5	Define and apply metrics to measure the performance of various data mining algorithms.	L1,L2,L3
6	Apply BI to solve practical problems: Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support.	L1,L2,L3

Prerequisite: Database Management System

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Knowledge of databases	01	-
I	Data Warehouse (DWH) Fundamentals with Introduction to Data Mining	DWH characteristics, Dimensional modeling: Star, Snowflakes, OLAP operation, OLTP vs OLAP Data Mining as a step in KDD, Kind of patterns to be mined, Technologies used, Data Mining applications. Self-learning Topics: Data Marts, Major issues in Data Mining.	04	CO1
II	Data Exploration and Data Preprocessing	Types of Attributes, Statistical Description of Data, Measuring Data Similarity and Dissimilarity. Why Preprocessing? Data Cleaning, Data Integration, Data Reduction: Attribute Subset Selection, Histograms, Clustering, Sampling, Data Cube aggregation, Data transformation and Data Discretization: Normalization, Binning, Histogram Analysis Self-learning Topics Data Visualization, Concept hierarchy generation	06	CO2, CO3



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

III	Classification	Basic Concepts; Classification methods: 1. Decision Tree Induction: Attribute Selection Measures, Tree pruning. 2. Bayesian Classification: Naïve Bayes Classifier. Prediction: Structure of regression models; Simple linear regression, Accuracy and Error measures, Precision, Recall, Holdout, Random Sampling, Cross Validation, Bootstrap, Introduction of Ensemble methods, Bagging, Boosting, AdaBoost and Random forest. Self-learning Topics: Multiple linear regression, logistic regression, Random forest, nearest neighbour classifier, SVM	08	CO4, CO5
IV	Clustering and Outlier Detection	Cluster Analysis: Basic Concepts; Partitioning Methods: K-Means, K Medoids; Hierarchical Methods: Agglomerative, Divisive, BIRCH; Density-Based Methods: DBSCAN. What are outliers? Types, Challenges; Outlier Detection Methods: Supervised, Semi Supervised, Unsupervised, Proximity based, Clustering Based. Self-learning Topics Hierarchical methods : Chameleon, Density based methods: OPTICS, Grid based methods: STING, CLIQUE	08	CO4
V	Frequent Pattern Mining	Basic Concepts: Market Basket Analysis, Frequent Itemset, Closed Itemset, and Association Rules; Frequent Itemset. Mining Methods: The Apriori Algorithm: Finding Frequent Itemset Using Candidate Generation, Generating Association Rules from Frequent Itemset, Improving the Efficiency of Apriori, A pattern growth approach for mining Frequent Itemset, Mining Frequent Itemset using vertical data formats; Introduction to Advance Pattern Mining: Mining Multilevel Association Rules and Multidimensional Association Rules. Self-learning Topics: Association Mining to Correlation Analysis, lift, Introduction to Constraint-Based Association Mining	08	CO4, CO5
VI	Business Intelligence	What is BI? Business intelligence architectures; Definition of decision support system; Development of a business intelligence system using Data Mining for business Applications like Fraud Detection, Recommendation System Self-learning Topics: Clickstream Mining,	04	CO6



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

		Market Segmentation, Retail industry, Telecommunications industry, Banking & finance CRM, Epidemic prediction, Fake News Detection, Cyberbullying, Sentiment Analysis etc.		

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.
2. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education.
3. Paulraj Ponniah "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" Wiley Publications
4. Business Intelligence: Data Mining and Optimization for Decision Making by Carlo Vercellis, Wiley India Publications.
5. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 2nd Edition, Wiley India.

References:

1. Michael Berry and Gordon Linoff "Data Mining Techniques", 2nd Edition Wiley Publications.
2. Michael Berry and Gordon Linoff "Mastering Data Mining- Art & science of CRM", Wiley Student Edition.
3. Vikram Pudi & Radha Krishna, "Data Mining", Oxford Higher Education.
4. Data Mining https://onlinecourses.nptel.ac.in/noc21_cs06/preview



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC602	Web X.0	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC602	Web X.0	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the digital evolution of web technology.
2	To learn Type Script and understand how to use it in web application.
3	To empower the use of AngularJS to create web applications that depend on the Model-View-Controller Architecture.
4	To gain expertise in a leading document-oriented NoSQL database, designed for speed, scalability, and developer agility using MongoDB.
5	To build web applications quickly and with less code using Flask framework.
6	To gain knowledge of Rich Internet Application Technologies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts related to web analytics and semantic web.	L1, L2
2	Understand how TypeScript can help you eliminate bugs in your code and enable you to scale your code.	L1, L2
3	Understand AngularJS framework and build dynamic, responsive single-page web applications.	L2, L3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



4	Apply MongoDB for frontend and backend connectivity using REST API.	L1, L2, L3
5	Apply Flask web development framework to build web applications with less code.	L1, L2, L3
6	Develop Rich Internet Application using proper choice of Framework.	L1, L2, L3, L4

Prerequisite: Object Oriented Programming, Python Programming, HTML and CSS.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	HTML/HTML5 (Tags, Attributes and their properties), CSS/CSS3 (Types and Properties), Basics of Java Script, Python Programming	02	--
I	Introduction to WebX.0	Evolution of WebX.0; Web Analytics 2.0: Introduction to Web Analytics, Web Analytics 2.0, Clickstream Analysis, Strategy to choose your web analytics tool, Measuring the success of a website; Web3.0 and Semantic Web: Characteristics of Semantic Web, Components of Semantic Web, Semantic Web Stack, N-Triples and Turtle, Ontology, RDF and SPARQL Self-learning Topics: Semantic Web Vs AI, SPARQL Vs SQL.	04	CO1
II	Type Script	Overview, TypeScript Internal Architecture, TypeScript Environment Setup, TypeScript Types, variables and operators, Decision Making and loops, TypeScript Functions, TypeScript Classes and Objects, TypeScript Modules Self-learning Topics: Javascript Vs TypeScript	06	CO2
III	Introduction to AngularJS	Overview of AngularJS, Need of AngularJS in real web sites, AngularJS modules, AngularJS built-in directives, AngularJS custom directives, AngularJS expressions, Angular JS Data Binding, AngularJS filters, AngularJS controllers, AngularJS scope, AngularJS dependency injection, Angular JS Services, Form Validation, Routing using ng-Route, ng-Repeat, ng-style, ng-view, Built-in Helper Functions, Using Angular JS with Typescript Self-learning Topics: MVC model, DOM model, Javascript functions and Error Handling	08	CO3



IV	MongoDB and Building REST API using MongoDB	MongoDB: Understanding MongoDB, MongoDB Data Types, Administering User Accounts, Configuring Access Control, Adding the MongoDB Driver to Node.js, Connecting to MongoDB from Node.js, Accessing and Manipulating Databases, Manipulating MongoDB Documents from Node.js, Accessing MongoDB from Node.js, Using Mongoose for Structured Schema and Validation. REST API: Examining the rules of REST APIs, Evaluating API patterns, Handling typical CRUD functions (create, read, update, delete), Using Express and Mongoose to interact with MongoDB, Testing API endpoints Self-learning Topics: MongoDB vs SQL DB	08	CO4
V	Flask	Introduction, Flask Environment Setup, App Routing, URL Building, Flask HTTP Methods, Flask Request Object, Flask cookies, File Uploading in Flask Self-learning Topics: Flask Vs Django	06	CO5
VI	Rich Internet Application	AJAX: Introduction and Working Developing RIA using AJAX Techniques: CSS, HTML, DOM, XML HTTP Request, JavaScript, PHP, AJAX as REST Client Introduction to Open Source Frameworks and CMS for RIA: Django, Drupal, Joomla Self-learning Topics: Applications of AJAX in Blogs, Wikis and RSS Feeds	05	CO6

Text Books:

1. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc.
2. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd.
3. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications.
4. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly.
5. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions.

References:

1. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications.
2. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress
3. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Online References:

Sr. No.	Website Links
1.	https://www.nptel.ac.in
2.	https://swayam.gov.in
3.	https://www.coursera.org
4.	https://udemy.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC603	Wireless Technology	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC603	Wireless Technology	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Discuss the Fundamentals of Wireless Communication.
2	Comprehend the Fundamental Principles of Wide Area Wireless Networking Technologies and their Applications.
3	Explain Wireless Metropolitan and Local Area Networks.
4	Describe Wireless Personal Area Networks and Ad hoc Networks
5	Learn and Analyze Wireless Network Security Standards.
6	Study the Design Considerations for Wireless Networks.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concepts of Wireless Network and Wireless Generations.	L1,L2
2	Demonstrate and Evaluate the various Wide Area Wireless Technologies.	L1,L2,L3, L4, L5
3	Analyze the prevalent IEEE standards used for implementation of WLAN and WMAN Technologies	L1,L2,L3,L4
4	Appraise the importance of WPAN, WSN and Ad-hoc Networks.	L1,L2,L3,L4,L5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



5	Analyze various Wireless Network Security Standards.	L1,L2,L3,L4
6	Review the design considerations for deploying the Wireless Network Infrastructure.	L1,L2

Prerequisite: Principle of Communication, Computer Network and Network Design, Computer Network Security.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Digital Modulation Techniques – ASK, FSK, BPSK, QPSK; Electromagnetic Spectrum; Multiplexing Techniques – FDM, TDM, OFDM; OSI and TCP/IP Model; Need for Security, Types of Security Threats and Attacks.	02	--
I	Fundamentals of Wireless Communication	Introduction to Wireless Communication - Advantages, Disadvantages and Applications; Multiple Access Techniques - FDMA, TDMA, CDMA, OFDMA; Spread Spectrum Techniques – DSSS, FHSS; Evolution of wireless generations – 1G to 5G (Based on technological differences and advancements); 5G – Key requirements and drivers of 5G systems, Use cases, Massive MIMO. Self-learning Topics: Modulation Techniques - QAM, MSK, GMSK	07	CO1
II	Wide Area Wireless Networks	Principle of Cellular Communication – Frequency Reuse concept, cluster size and system capacity, co- channel interference and signal quality; GSM – System Architecture, GSM Radio Subsystem, Frame Structure; GPRS and EDGE – System Architecture; UMTS – Network Architecture; CDMA 2000 – Network Architecture; LTE – Network Architecture; Overview of LoRa & LoRaWAN. Self-learning Topics:- IS-95	09	CO2
III	Wireless Metropolitan and Local Area Networks	IEEE 802.16 (WiMax) – Mesh mode, Physical and MAC layer; IEEE 802.11(Wi-Fi) – Architecture, Protocol Stack, Enhancements and Applications. Self-learning Topics:- WLL(Wireless Local Loop).	06	CO3



IV	Wireless Personal Area Networks and Ad hoc Networks	IEEE 802.15.1 (Bluetooth) – Piconet, Scatter net, Protocol Stack; IEEE 802.15.4 (ZigBee) – LR-WPAN Device Architecture, Protocol Stack; Wireless Sensor Network – Design Considerations, Issues and Challenges, WSN Architecture, Applications; Introduction of Ad hoc Networks – MANET and VANET – Characteristics, Applications, Advantages and Limitations; Over view of E-VANET(Electrical Vehicular AdHoc Networks). Self-learning Topics:- HR–WPAN (UWB)	08	CO4
V	Wireless Network Security	Security in GSM; UMTS Security; Bluetooth Security; WEP; WPA2. Self-learning Topics :- Study of Wireless Security Tools.	04	CO5
VI	Wireless Network Design Considerations	Cisco Unified Wireless Network; Designing Wireless Networks with Lightweight Access Points and Wireless LAN Controllers. Self-learning Topics:- Cisco Unified Wireless Network Mobility Services.	03	CO6

Text Books:

1. Wireless Communications, T.L. Singal, McGraw Hill Education.
2. Wireless Communications and Networking, Vijay Garg, Morgan Kaufmann Publishers.
3. Wireless Mobile Internet Security, 2nd Edition, Man Young Rhee, A John Wiley & Sons, Ltd., Publication.
4. 5G Outlook–Innovations and Applications, Ramjee Prasad, River Publishers Series in Communications.
5. Designing for Cisco Internetwork Solutions, 2nd Edition, CCDA, Diane Teare, Cisco Press.

Reference Books:

1. Cellular Communications: A Comprehensive and Practical Guide, Nishith Tripathi, Jeffery H Reed, Wiley.
2. Wireless Communications- Principles & Practice, Theodore S. Rappaport, Prentice Hall Series.
3. Wireless Communications and Networks", William Stallings, Pearson / Prentice Hall.
4. Adhoc & Sensor Networks Theory and Applications, Carlos de Moraes Cordeiro, Dharma Prakash Agrawal, World Scientific, 2nd Edition.
5. Wireless Networks, Nicopolitidia, M S Obaidat, GI Papadimitriou, Wiley India (Student Edition, 2010).

Online References:

Sr. No.	Website/Reference link
1.	www.swayam.gov.in
2.	www.coursera.org
3.	https://doi.org/10.1007/978-3-642-17878-8_63
4.	https://doi.org/10.1007/978-3-642-54525-2_44
5.	https://lora-alliance.org/resource_hub/what-is-lorawan/
6.	https://doi.org/10.1007/s42835-021-00687-8



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC604	AI and DS - 1	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITC604	AI and DS - 1	20	20	40	60	2.5	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To introduce the students' with different issues involved in trying to define and simulate intelligence.
2	To familiarize the students' with specific, well known Artificial Intelligence methods, algorithms and knowledge representation schemes.
3	To introduce students' different techniques which will help them build simple intelligent systems based on AI/IA concepts.
4	To introduce students to data science and problem solving with data science and statistics.
5	To enable students to choose appropriately from a wider range of exploratory and inferential methods for analyzing data, and interpret the results contextually.
6	To enable students to apply types of machine learning methods for real world problems.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents.	L1
2	Apply an appropriate problem-solving method and knowledge-representation scheme.	L1,L2,L3
3	Develop an ability to analyze and formalize the problem (as a state space, graph, etc.). They will be able to evaluate and select the appropriate search method.	L1,L2,L3,L4
4	Apply problem solving concepts with data science and will be able to tackle them from a statistical perspective.	L1,L2,L3



5	Choose and apply appropriately from a wider range of exploratory and inferential methods for analyzing data and will be able to evaluate and interpret the results contextually.	L1,L2,L3
6	Understand and apply types of machine learning methods for real world problems.	L1,L2, L3

Prerequisite:

1. Engineering Mathematics III
2. Data Structures and Analysis
3. Engineering Mathematics IV

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Nil	--	--
I	Introduction to AI	Introduction: Introduction to AI, AI techniques, Problem Formulation. Intelligent Agents: Structure of Intelligent agents, Types of Agents, Agent Environments PEAS representation for an Agent. Self-Learning Topics : Identify application areas of AI	04	CO1
II	Search Techniques	Uninformed Search Techniques: Uniform cost search, Depth Limited Search, Iterative Deepening, Bidirectional search. Informed Search Methods: Heuristic functions, Best First Search, A*, Hill Climbing, Simulated Annealing. Constraint Satisfaction Problem Solving: Crypto-Arithmetic Problem, Water Jug, Graph Coloring. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning. Comparing Different Techniques. Self-Learning Topics : IDA*, SMA*	09	CO2
III	Knowledge Representation using First Order Logic	Knowledge and Reasoning: A Knowledge Based Agent, WUMPUS WORLD Environment, Propositional Logic, First Order Predicate Logic, Forward and Backward Chaining, Resolution. Planning as an application of a knowledge based agent. Concepts of Partial Order planning, Hierarchical Planning and Conditional Planning. Self-Learning Topics: Representing real world problems as planning problems.	06	CO3



IV	Introduction to DS	Introduction and Evolution of Data Science, Data Science Vs. Business Analytics Vs. Big Data, Data Analytics, Lifecycle, Roles in Data Science Projects. Self-Learning Topics : Applications and Case Studies of Data Science in various Industries	04	CO4
V	Exploratory Data Analysis	Introduction to exploratory data analysis, Typical data formats. Types of EDA, Graphical/Non graphical Methods, Univariate/multivariate methods Correlation and covariance, Degree of freedom Statistical Methods for Evaluation including ANOVA. Self-Learning Topics: Implementation of graphical EDA methods.	08	CO5
VI	Introduction to ML	Introduction to Machine Learning, Types of Machine Learning: Supervised (Logistic Regression, Decision Tree, Support Vector Machine) and Unsupervised (K Means Clustering, Hierarchical Clustering, Association Rules) Issues in Machine learning, Application of Machine Learning Steps in developing a Machine Learning Application. Self-Learning Topics : Real world case studies on machine learning	08	CO6

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, 2nd Edition, Pearson Education.
2. Elaine Rich, Kevin Knight, Shivshankar B Nair, Artificial Intelligence, McGraw Hill, 3rd Edition.
3. Howard J. Seltman, Experimental Design and Analysis, Carnegie Mellon University, 2012/1.
4. Ethem Alpaydm, "Introduction to Machine Learning", MIT Press

References:

1. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
2. George Luger, AI-Structures and Strategies for Complex Problem Solving., 4/e, 2002, Pearson Education.
3. Data Science & Big Data Analytics, 1st Edition, 2015, EMC Education Services, Wiley.
ISBN: 978- 1118876138
4. Tom M.Mitchell "Machine Learning" McGraw Hill
5. Richard I. Levin, David S. Rubin "Statistics for Management" Pearson
6. Vivek Belhekar, "Statistics for Psychology using R" SAGE



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Online References:

Sr. No.	Website/Reference link
1.	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs83/
2.	https://nptel.ac.in/courses/106/105/106105077/
3.	https://www.coursera.org/specializations/jhu-data-science
4.	https://www.coursera.org/learn/machine-learning
5.	https://www.udemy.com/course/statistics-for-data-science-and-business-analysis/

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL606	Business Intelligence Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL606	Business Intelligence Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
	The Lab experiments aims:
1	To introduce the concept of data Mining as an important tool for enterprise data management and as a cutting-edge technology for building competitive advantage
2	To enable students to effectively identify sources of data and process it for data mining
3	To make students well versed in all data mining algorithms, methods, and tools.
4	To learn how to gather and analyze large sets of data to gain useful business understanding.
5	To impart skills that can enable students to approach business problems analytically by identifying opportunities to derive business value from data.
6	To identify and compare the performance of business.



Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify sources of Data for mining and perform data exploration	L2
2	Organize and prepare the data needed for data mining algorithms in terms of attributes and class inputs, training, validating, and testing files	L2
3	Implement the appropriate data mining methods like classification, clustering or association mining on large data sets using open-source tools like WEKA	L3
4	Implement various data mining algorithms from scratch using languages like Python/ Java etc.	L3
5	Evaluate and compare performance of some available BI packages	L3, L4
6	Apply BI to solve practical problems: Analyze the problem domain, use the data collected in enterprise apply the appropriate data mining technique, interpret and visualize the results and provide decision support	L3, L4

Prerequisite: Object oriented Concept, Java programming language, Python.

Hardware & Software Requirements:

Hardware Requirements	Software Requirements
PC i3 processor and above	Open source data mining and BI tools like WEKA, Rapid Miner, Pentaho

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	--	----	--
I	I	Tutorial on a) Design Star and Snowflake Schema	02	LO 1
II	II	Implement using tools or languages like JAVA/ python/R a) Data Exploration b) Data preprocessing	04	LO 2



III	III	Implement and evaluate using languages like JAVA/ python/R a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms	06	LO4
IV	IV	Perform and evaluate using any open-source tools a) Classification Algorithms b) Clustering Algorithms c) Frequent Pattern Mining Algorithms	04	LO3
V	V	Detailed case study of any one BI tool such as Pentaho, Tableau and QlikView	04	LO5
VI	VI	Business Intelligence Mini Project: Each group assigned one new case study for this A BI report must be prepared outlining the following steps: a) Problem definition, identifying which data mining task is needed b) Identify and use a standard data mining dataset available for the problem. Some links for data mining datasets are: WEKA, Kaggle, KDD cup, Data Mining Cup, UCI Machine Learning Repository etc. c) Implement appropriate data mining algorithm d) Interpret and visualize the results e) Provide clearly the BI decision that is to be taken as a result of mining	06	LO6

Text Books:

1. Han, Kamber, "Data Mining Concepts and Techniques", Morgan Kaufmann 3rd Edition.
2. G. Shmueli, N.R. Patel, P.C. Bruce, "Data Mining for Business Intelligence: Concepts, Techniques, and Applications in Microsoft Office Excel with XLMiner", 1st Edition, Wiley India.
3. Paulraj Ponniah "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals" Wiley Publications

References:

1. P. N. Tan, M. Steinbach, Vipin Kumar, "Introduction to Data Mining", Pearson Education
2. WEKA, RapidMiner Pentaho resources from the Web.
3. <https://www.kaggle.com/learn/overview>
4. Python for Data Science https://onlinecourses.nptel.ac.in/noc21_cs33/preview

Term Work: Term Work shall consist of at least 10 racticals based on the above list. Also Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiment) + 10 Marks (Mini Project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL607	Web Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL607	Web Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Open Source Tools for Web Analytics and Semantic Web.
2	Programming in TypeScript for designing Web Applications.
3	AngularJS Framework for Single Page Web Applications.
4	AJAX for Rich Internet Applications.
5	REST API and MongoDB for Frontend and Backend Connectivity.
6	Flask Framework for building web applications.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand open source tools for web analytics and semantic web apps development and deployment.	L1, L2
2	Understand the basic concepts of TypeScript for designing web applications.	L1, L2, L3
3	Implement Single Page Applications using AngularJS Framework.	L1, L2, L3



4	Develop Rich Internet Applications using AJAX.	L1, L2, L3
5	Create REST Web services using MongoDB.	L1, L2, L3, L4
6	Design web applications using Flask.	L1, L2, L3, L4

Prerequisite: HTML/HTML5, CSS/CSS3, JavaScript, Python

Hardware & Software requirements:

Hardware Specifications	Software Specifications
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Angular IDE, Visual Studio Code, Notepad++, Python Editors, MySQL, XAMPP, MongoDB, JDK

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Web Analytics & Semantic Web	Study Any 1 tool in each 1. Study web analytics using open source tools like Matomo, Open Web Analytics, AWStats, Countly, Plausible. 2. Study Semantic Web Open Source Tools like Apache TinkerPop, RDFLib, Apache Jena, Protégé, Sesame.	02	LO1
II	TypeScript	Perform Any 3 from the following 1. Small code snippets for programs like Hello World, Calculator using TypeScript. 2. Inheritance example using TypeScript 3. Access Modifiers example using TypeScript 4. Building a Simple Website with TypeScript	04	LO2
III	AngularJS	Perform Any 2 from the following 1. Create a simple HTML “Hello World” Project using AngularJS Framework and apply ng-controller, ng-model and expressions. 2. Events and Validations in AngularJS. (Create functions and add events, adding HTML validators, using \$valid property of Angular, etc.) 3. Create an application for like Students Record using AngularJS	06	LO3



IV	Rich Internet Application using AJAX	Perform Any 3 from the following 1. Write a JavaScript program for a AJAX. 2. Write a program to use AJAX for user validation using and to show the result on the same page below the submit button.	06	LO4
		3. Design and develop small web application using AJAX, HTML and JSP.		
V	MongoDB and Building REST API using MongoDB	Perform Any 1 from the following 1. Build a RESTful API using MongoDB. 2. Build a TypeScript REST API using MongoDB.	04	LO5
VI	Flask	Perform Any 3 from the following 1. Design Feedback Form using Flask. 2. Design Weather App using Flask. 3. Design Portfolio Website using Flask. 4. Create a complete Machine learning web application using React and Flask.	04	LO6

Text Books:

1. John Hebler, Matthew Fisher, Ryan Blace, Andrew Perez-Lopez, "Semantic Web Programming", Wiley Publishing, Inc, 1st Edition, 2009.
2. Boris Cherny, "Programming TypeScript- Making Your Javascript Application Scale", O'Reilly Media Inc., 2019 Edition.
3. Adam Bretz and Colin J. Ihrig, "Full Stack JavaScript Development with MEAN", SitePoint Pty. Ltd., 2015 Edition.
4. Simon Holmes Clive Harber, "Getting MEAN with Mongo, Express, Angular, and Node", Manning Publications, 2019 Edition.
5. Dr. Deven Shah, "Advanced Internet Programming", StarEdu Solutions, 2019 Edition.
6. Miguel Grinberg, "Flask Web Development: Developing Web Applications with Python", O'Reilly, 2018 Edition.

References:

1. John Davies, Rudi Studer and Paul Warren, "Semantic Web Technologies Trends and Research in Ontology-based Systems", Wiley, 2006 Edition.
2. Yakov Fain and Anton Moiseev, "TypeScript Quickly", Manning Publications, 2020 Edition.
3. Steve Fenton, "Pro TypeScript: Application - Scale Javascript Development", Apress, 2014 Edition.
4. Brad Dayley, Brendan Dayley, Caleb Dayley, "Node.js, MongoDB and Angular Web Development: The definitive guide to using the MEAN stack to build web applications", 2nd Edition, Addison-Wesley Professional, 2018 Edition.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term Work Journal must include at least 2 assignments.

Term Work Marks:

25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL608	Sensor Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL608	Sensor Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Learn various communication technologies, Microcontroller boards and sensors.
2	Design the problem solution as per the requirement analysis done using sensors and technologies.
3	Study the basic concepts of programming/sensors/ emulators.
4	Design and implement the mini project intended solution for project based learning.
5	Build, test and report the mini project successfully.
6	Improve the team building, communication and management skills of the students.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Differentiate between various wireless communication technologies based on the range of communication, cost, propagation delay, power and throughput.	L1,L2
2	Conduct a literature survey of sensors used in real world wireless applications.	L1,L2
3	Demonstrate the simulation of WSN using the Network Simulators (Contiki/ Tinker CAD/ Cup carbon etc).	L1,L2,L3
4	Demonstrate and build the project successfully by hardware/sensor	L1,L2,L3



	requirements, coding, emulating and testing	
5	Report and present the findings of the study conducted in the preferred domain.	L1,L2,L3
6	Demonstrate the ability to work in teams and manage the conduct of the research study.	L1,L2,L3

Prerequisite: Computer Networks, Microprocessor Lab.

Hardware & Software requirements:

Hardware Specifications:	Software Specifications:
1. Laptop/ PC with minimum 2GB RAM and 500 GB Hard disk drive. 2. Sensors –DHT11/22, PIR, MQ2/MQ3, HC-SR04, Moisture sensor , Arduino Uno/Mega board, RPi Board 3. Wireless Radio Modules- Zigbee RF module, Bluetooth Module (HC-05), Mobile Phone with Bluetooth antenna 4. Others-Breadboard, wires, power supplies, USB cables, buzzers, LEDs, LCDs.	1. Windows or Linux Desktop OS Arduino IDE 2. XCTU configuration and test utility software 3. CupCarbon IOT simulator 4. Tinkercad Simulation Software 5. Contiki/Cooja 6. Internet connection

Guidelines

A. **Students should perform the following experiments:**

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Introduction to 8086, 8051 and Python programming	02	--
I	Review of Wireless Communication Technologies	Study of various wireless communication technologies like IEEE 802.15.1, IEEE 802.15.4 and IEEE 802.11. Mini Project: Allocation of the groups	02	LO1
II	Sensors and their Interfacing	Study of various types of sensors and display devices (eg. DHT-11/22, HC-SR04, MFRC 522, PIR Sensor) and demonstration of their interfacing using Arduino/ Raspberry pi. Mini Project: Topic selection	02	LO2
III	Wireless Communication tools	Installation and testing the simulation tools (eg. TinkerCad/Cupcarbon/ContikiCooja). Mini Project: Topic validation and finalizing software and Hardware requirement.	02	LO3
IV	Implementation of Wireless Technologies	Study of interfacing of Arduino/ Raspberry pi with Wireless Technologies (eg. HC-05, XBee S2C by Digi, ESP controller).	02	LO4



		Mini Project: Hardware procurement		
V	Remote Access	Study of interface using Mobile/Web to publish or remotely access the data on the Internet. Mini Project: Study of remote access technologies with respect to the selected project.	02	LO4
VI	Mini Project	Implementation of the Mini Project: Design, configure, testing the Mini Project. Report submission as per the guidelines.	14	LO4,LO5 ,LO6

B. Mini project

1. Students should carry out hardware based mini-project in a group of three/four students with a subject In charge/ mini project mentor associated with each group.
2. The group should meet with the concerned faculty during laboratory hours and the progress of work discussed must be documented.
3. Each group should perform a detailed literature survey and formulate a problem statement.
4. Each group will identify the hardware and software requirement for their defined mini project problem statement.
5. Design, configure and test their own circuit board.
5. Interface using Mobile/Web to publish or remotely access the data on the Internet.
6. A detailed report is to be prepared as per guidelines.
7. Each group may present their work in various project competitions and paper presentations

C. Documentation of the Mini Project

The Mini Project Report can be made on following lines:

1. Abstract
2. Contents
3. List of figures and tables
4. Chapter-1 (Introduction, Literature survey, Problem definition, Objectives, Proposed Solution, Wireless Technology used)
5. Chapter-2 (System design/Block diagram, Flow chart, Circuit/Interfacing diagram, Hardware and Software requirements, cost estimation)
6. Chapter-3 (Implementation snapshots/figures with explanation, code, future directions)
7. Chapter-4 (Conclusion)
8. References



Text Books:

1. Fundamentals of Sensor Network Programming: Applications and Technology, S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley Publications.
2. ContikiCooja User Guide.
3. Building Wireless Sensor Networks, Robert Faludi, O'Reilly Publications.

Reference Books:

1. Internet of Things (A Hands-on-Approach) , Vijay Madiseti , ArshdeepBahga.
2. A comparative review of wireless sensor network mote technologies, IEEE paper 2009.
3. Wireless Sensor Networks-Technology, Protocols and Applications, KazemSohraby, Daniel Minoli and TaiebZnati, Wiley Publications.
4. Adhoc& Sensor Networks Theory and Applications, Carlos de MoraesCordeiro,Dharma Prakash Agrawal, World Scientific,2nd Edition.

Online References:

Sr. No.	Website/Reference link
1.	https://www.digi.com/resources/documentation/digidocs/90001526/tasks/t_download_and_install_xct u.htm
2.	https://www.arduino.cc/en/software
3.	http://cupcarbon.com/

Term Work:

Term Work shall consist of Mini Project on above guidelines/syllabus. Also Term work must include at least 2 assignments and mini project report.

Term Work Marks: 25 Marks (Total marks) =15 Marks (Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL609	MAD & PWA Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL609	MAD & PWA Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	Learn the basics of the Flutter framework.
2	Develop the App UI by incorporating widgets, layouts, gestures and animation
3	Create a production ready Flutter App by including files and firebase backend service.
4	Learn the Essential technologies, and Concepts of PWAs to get started as quickly and efficiently as possible
5	Develop responsive web applications by combining AJAX development techniques with the jQuery JavaScript library.
6	Understand how service workers operate and also learn to Test and Deploy PWA.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On Completion of the course the learner/student should be able to:		
1	Understand cross platform mobile application development using Flutter framework	L1, L2
2	Design and Develop interactive Flutter App by using widgets, layouts, gestures and animation	L3
3	Analyze and Build production ready Flutter App by incorporating backend services and deploying on Android / iOS	L3, L4
4	Understand various PWA frameworks and their requirements	L1, L2
5	Design and Develop a responsive User Interface by applying PWA Design techniques	L3
6	Develop and Analyse PWA Features and deploy it over app hosting solutions	L3, L4

Prerequisite: HTML/HTML5, CSS3, Javascript

Hardware & Software Requirements:

Hardware Requirement: PC i3 processor and above	Software requirement: JDK 8 and above, Android studio, Flutter SDK, AngularJs, React, Vue, PWA Builder, Google Chrome Browser, Github account. Internet Connection

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Basics of Flutter Programming	Introduction of Flutter, Understanding Widget Lifecycle Events, Dart Basics, Widget Tree and Element Tree, Basics of Flutter installation, Flutter Hello World App.	02	LO1
II	Developing Flutter UI: Widgets, Layouts, Gestures, Animation	USING COMMON WIDGETS: SafeArea, AppBar, Column, Row, Container, Buttons, Text, RichText, Form, Images and Icon. BUILDING LAYOUTS : high level view of layouts, Creating the layout, Types of layout widgets APPLYING GESTURES: Setting Up GestureDetector, Implementing the Draggable and Dragtarget Widgets, Using the GestureDetector for Moving and Scaling ADDING ANIMATION TO AN APP : Using Animated Container, Using Animated CrossFade, Using Animated Opacity, Using Animation Controller, Using Staggered Animation	06	LO2



		CREATING AN APP'S NAVIGATION: Using the Navigator, Using the Named Navigator Route, Using the Bottom NavigationBar, Using the TabBar and TabBarView		
III	Creating Production Ready Apps	Working with files : Including libraries in your Flutter app, Including a file with your app, Reading/Writing to files, Using JSON. Using Firebase with Flutter: Adding the Firebase and Firestore Backend, Configuring the Firebase Project, Adding a Cloud Firestore Database and Implementing Security Testing and Deploying of Flutter Application: Widget testing, Deploying Flutter Apps on Android / iOS	04	LO3
IV	Introduction to Progressive Web App	Introduction to Progressive Web App - Why Progressive Web App - Characteristics of PWA - PWAs and Hybrid Apps vs. Mobile Apps - PWA Requirements: HTTPS, Service Workers, and Web App Manifest - PWA framework tools - Use cases	02	LO4
V	Creating Responsive UI	Creating Responsive UI using JQuery Mobile / Material UI / Angular UI / React UI - Understanding the concept of responsive web design - Comparing responsive, fluid, and adaptive web - keys to great Progressive Web App UX - Responsive Design – The Technicalities - Flexible grid-based layout - Flexible images and video - Smart use of CSS splitting the website behavior (media queries)	06	LO5



VI	Web App Manifest & Service Workers	Web App Manifest: Understand the basic format and workings of the Web App Manifest file. • Using an App Manifest to Make your App Installable • Understanding App Manifest Properties • Simulating the Web App on an Emulator • Installing the Web App - Prerequisites • Understanding manifest.json Service Workers: Making PWAs work offline with Service workers • Introduction to Service Workers • Service Workers Lifecycle (Registration, Installation and Activation) • Implement Service Workers Features (Events) • Handling cached content • Enabling offline functionality • Serving push notifications • Loading cached content for new users • Background synchronization • Using IndexedDB in the Service Worker • Geo-fencing Deploy a PWA to GitHub Pages as a free SSL enabled static app hosting solution. • Initialising the PWA as a Git repo • Testing with Lighthouse Deploying via GitHub Pages	06	LO6

Text Books:

1. Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020.
2. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019
3. Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web, Packt Publishing Limited ,2018
4. Building Progressive Web Apps,O'Reilly 2017
5. Progressive Web Apps with Angular: Create Responsive, Fast and Reliable PWAs Using Angular, Apress; 1st ed. edition (28 May 2019)

References:

1. Flutter in Action by Eric Windmill, MANING, 2019
2. Google Flutter Mobile Development Quick Start Guide.Packt,2019
3. Learning Progressive Web Apps: Building Modern Web Apps Using Service Workers ,Addison-Wesley Professional, 2020



Online References:

Sr. No.	Website/Reference link
1.	https://flutter.dev/docs/reference/tutorials
2.	https://www.tutorialspoint.com/flutter/index.htm
3.	https://www.javatpoint.com/flutter
4.	https://www.tutorialspoint.com/jquery_mobile/jqm_panel_responsive.htm
5.	https://www.w3schools.com/css/css_rwd_intro.asp
6	https://developers.google.com/web/updates/2015/12/getting-started-pwa
7	https://www.w3schools.com/react/
8	https://angular.io/docs
9	https://flaviocopes.com/service-workers/
10	https://blog.logrocket.com/how-to-build-a-progressive-web-app-pwa-with-node-js/

List of Experiments.

1. To install and configure Flutter Environment.
2. To design Flutter UI by including common widgets.
3. To create an interactive Form using form widget
4. To design a layout of Flutter App using layout widgets
5. To include icons, images, charts in Flutter app
6. To apply navigation, routing and gestures in Flutter App
7. To Connect Flutter UI with fireBase database
8. To test and deploy production ready Flutter App on Android platform
9. To create a responsive User Interface using jQuery Mobile/ Material UI/ Angular UI/ React UI for Ecommerce application.
10. To write meta data of your Ecommerce PWA in a Web app manifest file to enable “add to homescreen feature”.
11. To code and register a service worker, and complete the install and activation process for a new service worker for the E-commerce PWA.
12. To implement Service worker events like fetch, sync and push for E-commerce PWA.
13. To study and implement deployment of Ecommerce PWA to GitHub Pages.
14. To use google Lighthouse PWA Analysis Tool to test the PWA functioning.
15. To deploy an Ecommerce PWA using SSL enabled static hosting solution.

Assignment 1: MAD (Any one)

1. To Study basics of Dart language and design basic Flutter App
2. To include Files and JSON data in App
3. To build interactive App by including Flutter Gestures and Animations

Assignment 2: PWA (Any one)

1. To study the requirement for progressive web application for Ecommerce using the concept of service worker,



Webapp Manifest and framework tools

2. To Design a wireframe for simple PWA for E-commerce website
3. Case study for successful real life implementation of PWA.

Term Work:

Term Work shall consist of at least 10 to 12 practical's based on the above list. Also Term Work Journal must include at least 2 assignments as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical & Oral Exam: An Practical & Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITL610	DS using Python Lab	--	02	--	01	01

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ITL610	DS using Python Lab	--	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To know the fundamental concepts of data science and analytics
2	To learn data collection, preprocessing and visualization techniques for data science
3	To Understand and practice analytical methods for solving real life problems based on Statistical analysis
4	To learn various machine learning techniques to solve complex real-world problems
5	To learn streaming and batch data processing using Apache Spark
6	To map the elements of data science to perceive information



Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the concept of Data science process and associated terminologies to solve real-world problems	L1
2	Analyze the data using different statistical techniques and visualize the outcome using different types of plots.	L1, L2, L3, L4
3	Analyze and apply the supervised machine learning techniques like Classification, Regression or Support Vector Machine on data for building the models of data and solve the problems.	L1,L2, L3, L4
4	Apply the different unsupervised machine learning algorithms like Clustering, Decision Trees, Random Forests or Association to solve the problems.	L1, L2,L3
5	Design and Build an application that performs exploratory data analysis using Apache Spark	L1,L2,L3,L4,L5,L6
6	Design and develop a data science application that can have data acquisition, processing, visualization and statistical analysis methods with supported machine learning technique to solve the real-world problem	L1,L2,L3,L4,L5,L6

Prerequisite: Basics of Python programming and Database management system.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Introduction to Data Science and Data Processing using Pandas	i. Introduction, Benefits and uses of data science ii. Data Science tasks iii. Introduction to Pandas iv. Data preparation: Data cleansing, Data transformation, Combine/Merge /Join data, Data loading & preprocessing with pandas v. Data aggregation vi. Querying data in Pandas vii. Statistics with Pandas Data Frames viii. Working with categorical and text data ix. Data Indexing and Selection x. Handling Missing Data	04	LO1



II	Data Visualization and Statistics	i. Visualization with Matplotlib and Seaborn ii. Plotting Line Plots, Bar Plots, Histograms Density Plots, Paths, 3Dplot, Stream plot, Logarithmic plots, Pie chart, Scatter Plots and Image visualization using Matplotlib iii. Plotting scatter plot, box plot, Violin plot, swarm plot, Heatmap, Bar Plot using seaborn iv. Introduction to scikit-learn and SciPy v. Statistics using python: Linear algebra, Eigen value, Eigen Vector, Determinant, Singular Value Decomposition, Integration, Correlation, Central Tendency, Variability, Hypothesis testing, Anova, z- test, t-test and chi-square test.	04	LO2
III	Machine Learning	i. What is Machine Learning? ii. Applications of Machine Learning; iii. Introduction to Supervised Learning iv. Overview of Regression v. Support Vector Machine vi. Classification algorithms	05	LO3
IV	Unsupervised Learning	i. Introduction to Unsupervised Learning ii. Overview of Clustering iii. Decision Trees iv. Random Forests v. Association	05	LO4
V	Data analytics using Apache Spark	i. Introduction to Apache Spark ii. Architecture of Apache Spark iii. Modes and components iv. Basics of PySpark	04	LO5
VI	Case Studies	i. Understanding the different data science phases used in selected case study ii. Implementation of Machine learning algorithm for selected case study	04	L O 1, L O 6

Text Books:

1. Jake VanderPlas, "Python Data Science Handbook", O'Reilly publication
2. Frank Kane, "Hands-On Data Science and Python Machine Learning", packt publication
3. M.T. Savaliya, R.K. Maurya, G.M.Magar, "Programming with Python", 2nd Edition, Sybgen Learning.

References:

1. Armando Fandango, "Python Data Analysis", Second Edition, Packt publication.
2. Alberto Boschetti, Luca Massaron, "Python Data Science Essentials Second Edition", Packt Publishing
3. Davy Cielen, Arno D. B. Meysman, Mohamed Ali, "Introducing Data Science", Manning Publications.



Online References:

Sr. No.	Website/Reference link
1.	https://www.w3schools.com/python/pandas/default.asp
2.	https://matplotlib.org/stable/gallery/index.html
3.	https://seaborn.pydata.org/examples/index.html
4.	https://docs.scipy.org/doc/scipy/reference/linalg.html#module-scipy.linalg
5.	https://scikit-learn.org/stable/auto_examples/index.html
6	https://www.tutorialspoint.com/scipy/scipy_integrate.htm
7	https://machinelearningmastery.com/statistical-hypothesis-tests-in-python-cheat-sheet/
8	https://data-flair.training/blogs/data-science-project-ideas/

Suggested List of Experiments

For the following Experiments, use any available data set or download it from Kaggle/UCI or other repositories and use Python to solve each problem.

1. Data preparation using NumPy and Pandas
 - a. Derive an index field and add it to the data set.
 - b. Find out the missing values.
 - c. Obtain a listing of all records that are outliers according to the any field. Print out a listing of the 10 largest values for that field.
 - d. Do the following for the any field.
 - i. Standardize the variable.
 - ii. Identify how many outliers there are and identify the most extreme outlier.

Data Visualization / Exploratory Data Analysis for the selected data set using Matplotlib and Seaborn

- e. Create a bar graph, contingency table using any 2 variables.
 - f. Create normalized histogram.
 - g. Describe what this graphs and tables indicates?
2. Data Modeling
 - a. Partition the data set, for example 75% of the records are included in the training data set and 25% are included in the test data set. Use a bar graph to confirm your proportions.
 - b. Identify the total number of records in the training data set.
 - c. Validate your partition by performing a two-sample Z-test.
 3. Implementation of Statistical Hypothesis Test using Scipy and Sci-kit learn [Any one]



Normality Tests

Shapiro-Wilk Test
D'Agostino's K^2 Test
Anderson-Darling Test

Correlation Tests

Pearson's Correlation Coefficient
Spearman's Rank Correlation
Kendall's Rank Correlation
Chi-Squared Test

Stationary Tests

Augmented Dickey-Fuller
Kwiatkowski-Phillips-Schmidt-Shin

Parametric Statistical Hypothesis Tests

Student's t-test
Paired Student's t-test
Analysis of Variance Test (ANOVA)
Repeated Measures ANOVA Test

Nonparametric Statistical Hypothesis Tests

Mann-Whitney U Test
Wilcoxon Signed-Rank Test
Kruskal-Wallis H Test
Friedman Test

4. Regression Analysis

- Perform Logistic Regression to find out relation between variables.
- Apply regression Model techniques to predict the data on above dataset

5. Classification modelling

- Choose classifier for classification problem.
- Evaluate the performance of classifier.

6. Clustering

- Clustering algorithms for unsupervised classification.
- Plot the cluster data.

7. Using any machine learning techniques using available data set to develop a recommendation system.

8. Exploratory data analysis using Apache Spark and Pandas

9. Batch and Streamed Data Analysis using Spark

10. Implementation of Mini project based on following case study using Data science and Machine learning

[Any one]



List of Case Studies		
Fake News Detection	Road Lane Line Detection	Sentiment Analysis
Detecting Parkinson's Disease	Brain Tumor Detection with Data Science	Leaf Disease Detection
Speech Emotion Recognition	Gender Detection and Age prediction	Diabetic Retinopathy
Uber Data Analysis	Driver Drowsiness detection	Chatbot Project
Credit Card Fraud Detection	Movie/ Web Show Recommendation System	Customer Segmentation
Cancer Classification	Traffic Signs Recognition	Exploratory Data Analysis for Housing price prediction
Coronavirus visualizations	Visualizing climate change	Predictive policing
Uber's pickup analysis	Earth Surface Temperature Visualization	Web traffic forecasting using time series
Pokemon Data Exploration	Impact of Climate Change on Global Food Supply	Used Car Price Estimator
Skin Cancer Image Detection	World University Rankings	and so on

Assignments:

- 1) Recent trends in Data science
- 2) Comparative analysis between Batch and Streamed data processing tools like Map-reduce, Apache spark, Apache Flink, Apache Samza, Apache Kafka and Apache Storm.

Term Work:

- Term work shall consist of at least 10 experiments and a case study.
- Journal must include 2 assignments.
- The final certification and acceptance of term work indicates that performance in laboratory work is satisfactory and minimum passing marks may be given in term work.
- The distribution of marks for term work shall be as follows:
- Laboratory work (Experiments) (15) Marks.
- Mini project (Implementation) (05) Marks.
- Attendance (05) Marks
- TOTAL: (25) Marks.**

Oral examination will be based on Laboratory work, mini project and above syllabus.



Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITI611	Mini Project – 2 B Web Based on ML	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem Exam			
		IAT 1	IAT 2	Tot.				
ITl611	Mini Project – 2 B Based on ML	--	--	--	--	25	25	50

Course Objectives

- To acquaint with the process of identifying the needs and converting it into the problem.
- To familiarize the process of solving the problem in a group.
- To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
- To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to...

- Identify problems based on societal /research needs.
- Apply Knowledge and skill to solve societal problems in a group.
- Develop interpersonal skills to work as member of a group or leader.
- Draw the proper inferences from available results through theoretical/ experimental/simulations.
- Analyse the impact of solutions in societal and environmental context for sustainable development.
- Use standard norms of engineering practices
- Excel in written and oral communication.
- Demonstrate capabilities of self-learning in a group, which leads to life long learning.
- Demonstrate project management principles during project work.



Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book : 10
 - Marks awarded by review committee:10
 - Quality of Project report:05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:



- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.



Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on following points;

9. Quality of problem and Clarity
10. Innovativeness in solutions
11. Cost effectiveness and Societal impact
12. Full functioning of working model as per stated requirements
13. Effective use of skill sets
14. Effective use of standard engineering norms
15. Contribution of an individual's as member or leader
16. Clarity in written and oral communication



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC651	Software Architecture	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC651	Software Architecture	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the importance of architecture in building effective, efficient, competitive software products.
2	To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation
3	To learn the design principles and to apply for large scale systems including distributed, network and heterogeneous systems
4	To understand principal design decisions governing the system.
5	To understand different notations used for capturing design decisions.
6	To understand different functional and non-functional properties of complex software systems.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the need of software architecture for sustainable dynamic systems.	L1
2	Have a sound knowledge on design principles and to apply for large scale systems.	L2
3	Apply functional and non-functional requirements	L1,L2,L3
4	Design architectures for distributed, network and heterogeneous systems	L1,L2,L3
5	Have good knowledge on service oriented and model driven architectures and the aspect-oriented architecture.	L1,L2, L3
6	Have a working knowledge to develop appropriate architectures through various case studies.	L1,L2, L3



Prerequisite: Software Engineering, Any Programming Language

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts, Knowledge of Any programming Language	02	CO1
I	Basic Concepts and Architectures Design	Terminology, Models, Processes, Stakeholders, Design Process, Architectural Conceptions, Styles and architectural Patterns, Architectural conceptions in absences of experience, connectors, 4+1 view model of Architecture Self Learning Topics : Technical Paper “What is included in software architectur”	07	CO1
II	Architectur al Modeling and Analysis	Modeling Concepts, Ambiguity, Accuracy and Precisions, Complex Modeling, Evaluating Modeling Techniques, Specific Modeling Techniques, Analysis Goals, Scope of Analysis, Formality of Architectural Models, Types of Analysis, Level of Automation, System Stakeholders, Analysis Techniques Self Learning Topics: Technical Paper “Specification of Requirements and Software Architecture for the Customisation of Enterprise Software”	09	CO1, CO2
III	Implementati on, Deployment and Mobility	Implementation Concepts, Existing Frameworks, Overview of Deployment and Mobility Challenges, Software Architecture and Deployment, Software Architecture and Mobility Self Learning Topics: Technical Paper”Application of Distributed System in Neuroscience: A Case Study of BCI Framework”	06	CO1, CO2
IV	Applied Architecture s and Styles	Distributed and Network Architectures, Architectures for Network Based Applications, Decentralized Architectures, Service oriented Architectures and Web Services. Self Learning Topics: Technical Paper “Analysing the Behaviour of Distributed Software Architectures: a Case Study”	06	C O1 , C O2 , C O3



V	Designing for Non-Functional Properties	Efficiency, Complexity, Scalability and Heterogeneity, Adaptability, Dependability Self Learning Topics: Technical Paper “Threat-Modeling-in-Agile-Software-Development”	04	CO1,C O2, CO4, CO6
VI	Domain- Specific Software Engineering	Domain-Specific Software Engineering, Domain- Specific Architecture, Software Architects Roles Self Learning Topics: Research Paper “A Case Study of the Variability Consequences of the CQRS”	05	CO1,C O2, CO3

Text Books:

1. Software Architecture, Foundations, Theory, and Practise, Richard Taylor, Nenad Medvidovic, Eric M Dashofy, Wiley Student Edition.
2. The Art of Software Architecture: Design Methods and Techniques, Stephen T.Albin, Wiley India Private Limited.
3. Software Architecture in Practice by Len Bass, Paul Clements, Rick Kazman, Pearson

References:

1. DevOps A Software Architect’s Perspective, Len Bass, Ingo Weber, Liming Zhu, Addison Wesley
2. Essentials of Software Architecture, Ion Gorton, Second Edition, Springer-verlag, 2011

Online Resources:

1. ArchStudio Software
2. <https://www.coursera.org/learn/software-architecture>
3. <https://www.coursera.org/specializations/software-design-architecture>
4. <https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=509483>
5. <http://infolab.stanford.edu/~backrub/google.html>
6. <https://web.njit.edu/~alexg/courses/cs345/OLD/F15/solutions/f3345f15.pdf>



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC652	Image Processing	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC652	Image Processing	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	Define image and its formation and debate about the roles of image processing in today's world and also introduce students to the major research domains in the field of image processing.
2	Describe point, mask and histogram processing units of image enhancements that can be applied on a given image for improving the quality of digital image required for an application.
3	Explain the forward and reverse discrete image transforms and discuss the selection of the image transform used for enhancement, compression, or representation and description.
4	Make students understand the impacts and effects of image compression techniques over a given bandwidth to learn how effectively storage and retrieval can be achieved using lossy and lossless compression methods.
5	Describe and demonstrate the proper procedure for segmenting images, and demonstrate how the image object can be described using image representation techniques.
6	Illustrate how to shape and reshape a given object in an image using morphological techniques over binary and gray scale images.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define image and explain formation of image and recall its types and calculate image parameters by reading images using a programming language.	L1
2	Apply and differentiate point, mask and histogram processing techniques suitable for enhancing images required for an application.	L1,L2,L3
3	List and calculate discrete image transform coefficients and use it for enhancement, compression and representation.	L1,L2, L3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



4	Compute compression ratio and fidelity criteria to evaluate and compare method efficiency and classify compression techniques into lossless and lossy methods.	L1,L2,L3, L4
5	Apply the segmentation techniques to highlight and select the region of interest and determine and describe using chain code, shape number and moments for representing objects in an image.	L1,L2,L3
6	Choose structuring elements and apply morphological operations to find a suitable shape for an object in the image.	L1,L2,L3

Prerequisite: Digital Signal Processing.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Digital Signal Processing, Matrix Multiplication.	01	
I	Introduction to Image Processing	Image Fundamentals: Image Definition, Steps and Components of Image Processing, Image Sensing and Acquisition, Image Sampling and Quantization. Relationship Between Pixels: Adjacency, Connectivity and Distance. Self-Learning Topics: Different Image File Formats and Types of noise in image.	04	CO1
II	Image Enhancement	Point Processing Techniques: Image Negative, Bit Plane Slicing, Gray Level Slicing, Contrast Stretching, Clipping, Thresholding, Dynamic Range Compression. Mask Processing Techniques: Filtering in Spatial Domain, Average Filter, Weighted Average Filter, Order Statistic Filter: Min, Max, Median Filter. Histogram Processing: Histogram Equalization and Specification. Self-Learning Topics: Application of Image Enhancement in Spatial Domain.	08	CO2
III	Image Transforms	Discrete Fourier Transform: Transform Pair, Transform Matrix, Properties, Filtering in Frequency Domain. Other Discrete Transforms: Discrete Cosine Transform, Discrete Hadamard Transform, Discrete Walsh, Transform, Discrete Haar Transform. Self-Learning Topics: Application of Transforms in Steganography and CBIR.	07	CO3



IV	Image Compression	Entropy, Redundancy and Types, Compression Ratio, Compression Methods. Lossless Compression: Run-Length Encoding, Huffman Coding, Arithmetic Coding, LZW Coding, Lossless Predictive coding. Lossy Compression: Fidelity Criterion, Improved Gray scale Quantization, Symbol-Based Coding, Bit-Plane Coding, Vector Quantization. Self-Learning Topics: DPCM, Block Transform Coding, JPEG compression.	07	CO4
V	Image Segmentation and Representation	Image Segmentation: Point, Line and Edge Detections Methods, Hough Transform, Graph Theoretic Method, Region Based Segmentation. Image Representation: Chain Codes, Shape Number, Polygon Approximation, Statistical Moments. Self-Learning Topics: Fourier Descriptors, Otsu Thresholding, Application in Number Plate Recognition.	07	CO5
VI	Morphological Image Processing	Basic Morphological Methods: Erosion, Dilation, Opening, Closing, Hit-or-Miss Transformation. Advanced Morphological Methods: Skeletonization, Thinning, Thickening, Pruning, Boundary Extraction. Self-Learning Topics: Gray Scale Morphology: Erosion and Dilation.	05	CO6

Text Books:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Addison - Wesley Publishing Company, 3e, 2007.
2. William K. Pratt, "Digital Image Processing", John Wiley, 4e, 2007.
3. S. Jayaraman, S. Esakkirajan and T. Veerakumar, "Digital Image Processing", MGH Publication, 2016.

References:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing using MATLAB," Pearson Education.
2. J. G. Proakis and D. G. Manolakis, "Digital Signal processing Principles, Algorithms and Applications," PHI Publications, 3e.
3. Anil K. Jain, "Fundamentals of Digital Image Processing," PHI, 1995.
4. Milan Sonka, "Digital Image Processing and Computer Vision," Thomson publication, Second Edition.2007.
5. Kenneth R. Castleman, "Digital Image Processing," PHI, 1996.
6. S. Sridhar, "Digital Image Processing," Oxford University Press, 2e, 2016.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC653	Green IT	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC653	Green IT	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand what Green IT is and How it can help improve environmental Sustainability
2	To understand the principles and practices of Green IT.
3	To understand how Green IT is adopted or deployed in enterprises.
4	To understand how data centres, cloud computing, storage systems, software and networks can be made greener.
5	To measure the Maturity of Sustainable ICT world.
6	To implement the concept of Green IT in Information Assurance in Communication and Social Media and all other commercial field.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe awareness among stakeholders and promote green agenda and green initiatives in their working environments leading to green movement	L1
2	Identify IT Infrastructure Management and Green Data Centre Metrics for software development	L1,L2
3	Recognize Objectives of Green Network Protocols for Data communication.	L1,L2
4	Use Green IT Strategies and metrics for ICT development.	L1,L2,L3
5	Illustrate various green IT services and its roles.	L1,L2
6	Use new career opportunities available in IT profession, audits and others with special skills such as energy efficiency, ethical IT assets disposal, carbon footprint estimation, reporting and development of green products, applications and services.	L1,L2,L3



Prerequisite: Environmental Studies

DETAILED SYLLABUS:

Sr No	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Environmental Studies	2	
I	Introduction	Environmental Impacts of IT, Holistic Approach to Greening IT, Green IT Standards and Eco-Labeling, Enterprise Green IT Strategy Hardware: Life Cycle of a Device or Hardware, Reuse, Recycle and Dispose Software: Introduction, Energy-Saving Software Techniques Self learning Topics: Evaluating and Measuring Software Impact to Platform Power	7	CO 1
II	Software development and data centers	Sustainable Software, Software Sustainability Attributes, Software Sustainability Metrics Data Centres and Associated Energy Challenges, Data Centre IT Infrastructure, Data Centre Facility Infrastructure: Implications for Energy Efficiency, Green Data Centre Metrics Self-learning Topics: Sustainable Software: A Case Study, Data Centre Management Strategies: A Case Study	7	CO 1 CO 2
III	Data storage and communication	Storage Media Power Characteristics, Energy Management Techniques for Hard Disks Objectives of Green Network Protocols, Green Network Protocols and Standards Self learning Topics: System-Level Energy Management	6	CO 1 CO 3
IV	Information systems, green it strategy and metrics	Approaching Green IT Strategies, Business Drivers of Green IT Strategy Multilevel Sustainable Information, Sustainability Hierarchy Models, Product Level Information, Individual Level Information, Functional Level Information, Measuring the Maturity of Sustainable ICT: A Capability Maturity Framework for SICT, Defining the Scope and Goal, Capability Maturity Levels Self learning Topics: Business Dimensions for Green IT Transformation	6	CO 1 CO 4



V	Green IT services and roles	Factors Driving the Development of Sustainable IT, Sustainable IT Services (SITS), SITS Strategic Framework Organizational and Enterprise Greening, Information Systems in Greening Enterprises, Greening the Enterprise: IT Usage and Hardware Self learning Topics: Inter-organizational Enterprise Activities and Green Issues, Enablers and Making the Case for IT and the Green Enterprise	6	CO 1 CO 4 CO 5
VI	Managing and regulating green IT	Strategizing Green Initiatives, Implementation of Green IT, Communication and Social Media The Regulatory Environment and IT Manufacturers, Nonregulatory Government Initiatives, Industry Associations and Standards Bodies, Green Building Standards, Social Movements and Greenpeace. Self learning Topics: Information Assurance, Green Data Centers, Case Study: Managing Green IT	5	CO 1 CO 5 CO 6

Text Books:

1. San Murugesan, G. R. Gangadharan, Harnessing Green IT, WILEY 1st Edition-2013
2. Mohammad Dastbaz Colin Pattinson Babak Akhgar, Green Information Technology A Sustainable Approach, Elsevier 2015
3. Reinhold, Carol Baroudi, and Jeffrey Hill Green IT for Dummies, Wiley 2009

References:

1. Mark O'Neil, Green IT for Sustainable Business Practice: An ISEB Foundation Guide, BCS
2. Jae H. Kim, Myung J. Lee Green IT: Technologies and Applications, Springer, ISBN: 978-3-642-22178-1
3. Elizabeth Rogers, Thomas M. Kostigen The Green Book: The Everyday Guide to Saving the Planet One Simple Step at a Time, Springer



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- T.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)		Credits Assigned		
		Theory	Practical	Theory	Practical	Total
ITC654	Ethical Hacking and Forensics	03	--	03	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC654	Ethical Hacking and Forensics	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To understand the concept of cybercrime and principles behind ethical hacking.
2	To explore the fundamentals of digital forensics, digital evidence and incident response.
3	To learn the tools and techniques required for computer forensics.
4	To understand the network attacks and tools and techniques required to perform network forensics.
5	To learn how to investigate attacks on mobile platforms.
6	To generate a forensics report after investigation.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Define the concept of ethical hacking.	L1
2	Recognize the need of digital forensics and define the concept of digital evidence and incident response.	L1,L2
3	Apply the knowledge of computer forensics using different tools and techniques.	L1,L2,L3
4	Detect the network attacks and analyze the evidence.	L1, L2,L3,L4



5	Apply the knowledge of computer forensics using different tools and techniques.	L1,L2,L3
6	List the method to generate legal evidence and supporting investigation reports	L1,L2

Prerequisite: Computer Networks, Computer Network Security

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Networks, Computer Network Security	01	--
I	Cybercrime and Ethical Hacking	Introduction to Cybercrime, Types of Cybercrime, Classification of Cybercriminals, Role of computer in Cybercrime, Prevention of Cybercrime. Ethical Hacking, Goals of Ethical Hacking, Phases of Ethical Hacking, Difference between Hackers, Crackers and Phreakers, Rules of Ethical Hacking. Self Learning Topics: exploring various online hacking tools for Reconnaissance and scanning Phase.	06	CO1
II	Digital Forensics Fundamentals	Introduction to Digital Forensics, Need and Objectives of Digital Forensics, Types of Digital Forensics, Process of Digital Forensics, Benefits of Digital Forensics, Chain of Custody, Anti Forensics. Digital Evidence and its Types, Rules of Digital Evidences. Incident Response, Methodology of Incident Response, Roles of CSIRT in handling incident. Self Learning Topics: Pre Incident preparation and Incident Response process	06	CO2
III	Computer Forensics	Introduction to Computer Forensics, Evidence collection (Disk, Memory, Registry, Logs etc), Evidence Acquisition, Analysis and Examination(Window, Linux, Email, Web, Malware) , Challenges in Computer Forensics, Tools used in Computer Forensics. Self Learning Topics: Open source tool for Data collection & analysis in windows or Unix	08	CO3



IV	Network Forensics	Introduction, Evidence Collection and Acquisition (Wired and Wireless), Analysis of network evidences(IDS, Router,), Challenges in network forensics, Tools used in network forensics. Self Learning Topics: IDS types and role of IDS in attack prevention	08	CO4
V	Mobile Forensics	Introduction, Evidence Collection and Acquisition, Analysis of Evidences, Challenges in mobile forensics, Tools used in mobile forensics Self Learning Topics: Tools / Techniques used in mobile forensics	06	CO5
VI	Report Generation	Goals of Report, Layout of an Investigative Report, Guidelines for Writing a Report, sample for writing a forensic report. Self Learning Topics: For an incident write a forensic report.	04	CO6

Text Books:

1. John Sammons, “The Basics of Digital Forensics: The Premier for Getting Started in Digital Forensics”, 2nd Edition, Syngress, 2015.
2. Nilakshi Jain, Dhananjay Kalbande, “Digital Forensic: The fascinating world of Digital Evidences” Wiley India Pvt Ltd 2017.
3. Jason Luttgens, Matthew Pepe, Kevin Mandia, “Incident Response and computer forensics”, 3rd Edition Tata McGraw Hill, 2014.

References:

1. Sangita Chaudhuri, Madhumita Chatterjee, “Digital Forensics”, Staredu, 2019.
2. Bill Nelson, Amelia Phillips, Christopher Steuart, “Guide to Computer Forensics and Investigations” Cengage Learning, 2014.
3. Debra Littlejohn Shinder Michael Cross “Scene of the Cybercrime: Computer Forensics Handbook”, 2nd Edition Syngress Publishing, Inc. 2008.

B.E Syllabus

SEM 7



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC701	AI and DS –II	03	--	--	3	--	--	03

Coure Code	Coure Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Tot. of 2 Tests					
ITC701	AI and DS – II	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To model a decision making for a new problem in an uncertain domain.
2	To demonstrate Cognitive skills of Artificial Intelligence.
3	To become familiar with the basics of Fuzzy Logic and Fuzzy Systems.
4	To become familiar with Deep Learning Concepts and Architectures.
5	To define and apply metrics to measure the performance of various learning algorithms.
6	To enable students to analyze data science methods for real world problems.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Design models for reasoning with uncertainty as well as the use of unreliable information.	L1,L2,L3
2	Analyze the process of building a Cognitive application.	L1,L2,L3,L4
3	Design fuzzy controller system.	L1,L2,L3
4	Apply learning concepts to develop real life applications.	L1,L2,L3
5	Evaluate performance of learning algorithms.	L1,L2,L3,L4,L5
6	Analyze current trends in Data Science.	L1,L2,L3,L4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: AI and DS - 1 , Data Mining & Business Intelligence

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hou rs	CO Mapping
0	Prerequisite	Intelligent Agents, Search Techniques, Knowledge and Reasoning, Data Science, Machine Learning.	02	--
I	Uncertainty	Uncertainty in AI, Inference using full joint distributions, Bayes Theorem, the semantics of Bayesian Networks, Inference in Bayesian networks, Decision Theory, Markov Decision Processes. Self-learning Topics: Hidden Markov Model (HMM), Gaussian Mixture Model (GMM).	04	CO1
II	Cognitive Computing	Foundation of Cognitive Computing, Design Principles for Cognitive Systems, Natural Language Processing in Support of a Cognitive System, Representing Knowledge in Taxonomies and Ontologies, Applying Advanced Analytics to Cognitive Computing, The Process of Building a Cognitive Application. Self-learning Topics: Cognitive Systems such as IBM's Watson.	06	CO2
III	Fuzzy Logic & Its Applications	Introduction to Fuzzy Sets, Properties of Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Membership Functions, Fuzzy Relations with Operations and its Properties, Fuzzy Composition: Max-Min Composition, Max-Product Composition, Defuzzification Methods, Architecture of Mamdani Type Fuzzy Control System, Design of Fuzzy Controllers like Domestic Shower Controller, Washing Machine Controller, Water Purifier Controller, etc. Self-learning Topics: Other Fuzzy Composition Operations, Fuzzy Inference System (FIS) & ANFIS.	07	CO3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

IV	Introduction to Deep Learning	Introduction to Deep Learning, ANN, Machine Learning Vs Deep Learning, Working of Deep Learning; Convolutional Neural Network: Introduction, Components of CNN Architecture, Properties of CNN, Architectures of CNN, Applications of CNN, Recurrent Neural Network: Introduction, Simple RNN, LSTM Implementation, Deep RNN, Autoencoder: Introduction, Features, Types, Applications of Deep Learning. Self-learning Topics: Restricted Boltzmann Machine (RBM).	08	CO4
V	Advanced ML Classification Techniques	Ensemble Classifiers: Introduction to Ensemble Methods, Bagging, Boosting, Random forests, Improving classification accuracy of Class-Imbalanced Data. Metrics for Evaluating Classifier Performance, Holdout Method and Random Subsampling, Cross-Validation, Bootstrap, Model Selection Using Statistical Tests of Significance, Comparing Classifiers Based on Cost-Benefit and ROC Curves. Self-learning Topics: Introduction to ML (Revision), Introduction to Reinforcement Learning.	06	CO 4 CO 5
VI	Trends and applications in Data Science	Data Science: applications and case studies, Data science for text, image, video, audio. Data science for Multimodal applications. Self-learning Topics: ImageNet Large Scale Visual Recognition Challenge (ILSVRC).	06	CO 6

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Pearson Education.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley India, 2015.
3. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley Publication.
4. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, "Deep Learning Using Python", Wiley India, 2020.
5. B. Uma Maheshwari, R. Sujatha, "Introduction to Data Science Practical Approach with R and Python", Wiley India, 2021.
6. François Chollet, "Deep Learning with Python", Manning Publications, 2018.
7. Han J, Kamber M, Pei J, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann.

References:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publication.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd.
3. Jon Krohn, Grant Beyleveld, Aglae Bassens, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education.
4. Prateek Joshi, "Artificial Intelligence with Python", Packt Publishing.

Online References:

Sr. No.	Website Links
1	https://d2l.ai/index.html
2	https://onlinecourses.nptel.ac.in/noc20_cs62/preview
3	https://onlinecourses.nptel.ac.in/noc22_cs35/preview
4	https://www.coursera.org/specializations/deep-learning
5	https://onlinecourses.nptel.ac.in/noc22_cs56/preview

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC702	Internet of Everything	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC702	Internet of Everything	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To comprehend Characteristics and Conceptual Framework of IoT.
2	To understand levels of the IoT architectures.
3	To correlate the connection of smart objects and IoT access technologies.
4	To Interpret edge to cloud protocols.
5	To explore data analytics and data visualization on IoT Data.
6	To explore IoT applications.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the Characteristics and Conceptual Framework of IoT.	L1,L2
2	Differentiate between the levels of the IoT architectures.	L1,L2,L3,L4
3	Analyze the IoT access technologies.	L1,L2,L3,L4
4	Illustrate various edge to cloud protocol for IoT.	L1,L2,L3
5	Apply IoT analytics and data visualization.	L1,L2,L3
6	Analyze and evaluate IoT applications.	L1,L2,L3,L4

Prerequisite:

1. Python programming
2. C programming language
3. Computer Networks

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Ports, Timers ,Programming of controller , How to use IDE to write code of microcontroller, TCP-IP protocol stack	02	
I	Introduction to IoT	Introduction to IoT- Defining IoT, Characteristics of IoT, Conceptual Framework of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Brief review of applications of IoT. Smart Object – Definition, Characteristics and Trends Self-learning Topics: Hardware and software development tools for - Arduino, NodeMCU, ESP32, Raspberry Pi, for implementing internet of things, Simulators-Circuit.io,Eagle,Tinkercad	04	CO1
II	IoT Architecture	Drivers Behind New Network Architectures : Scale,Security,Constrained Devices and Networks ,Data,Legacy Device Support Architecture : The IoT World Forum (IoTWF) Standardized Architecture :Layer 1-7, IT and OT Responsibilities in the IoT Reference Model,Additional IoT Reference Models A Simplified IoT Architecture The Core IoT Functional Stack ::Layer 1-3 , Analytics Versus Control Applications , Data Versus Network Analytics Data Analytics Versus Business Benefits , Smart Services, IoT Data Management and Compute Stack : Fog Computing , Edge Computing ,The Hierarchy of Edge, Fog, and Cloud Self-learning Topics: Brief review of applications of IoT: Connected Roadways , Connected Factory, Smart Connected Buildings , Smart Creatures etc,	06	CO2
III	Principles of Connected Devices and Protocols in IoT	RFID and NFC (Near-Field Communication), Bluetooth Low Energy (BLE) roles, LiFi , WPAN std : 802.15 standards: Bluetooth, IEEE 802.15.4, Zigbee, Z-wave, Narrow Band IoT, Internet Protocol and Transmission Control Protocol, 6LoWPAN, WLAN and WAN , IEEE 802.11, Long-range Communication Systems and Protocols: Cellular Connectivity-LTE, LTE-A, LoRa and LoRaWAN.	08	CO3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

IV	Edge to Cloud Protocol	HTTP, WebSocket, Platforms. HTTP - MQTT - .Complex Flows: IoT Patterns: Real-time Clients, MQTT, MQTT-SN, Constrained Application Protocol (CoAP), Streaming Text Oriented Message Protocol (STOMP), Advanced Message Queuing Protocol (AMQP), Comparison of Protocols.	08	CO4
V	IoT and Data Analytics	Defining IoT Analytics, IoT Analytics challenges, IoT analytics for the cloud, Strategies to organize Data for IoT Analytics, Linked Analytics Data Sets, Managing Data lakes, The data retention strategy, visualization and Dashboarding-Designing visual analysis for IoT data, creating a dashboard ,creating and visualizing alerts. Self-learning Topics: AWS and Hadoop Technology	06	CO5
VI	IoT Application Design	Prototyping for IoT and M2M, Case study related to : Home Automation (Smart lighting, Home intrusion detection), Cities (Smart Parking), Environment (Weather monitoring, weather reporting Bot, Air pollution monitoring, Forest fire detection, Agriculture (Smart irrigation), Smart Library. Introduction to I-IoT, Use cases of the I- IoT,IoT and I-IoT – similarities and differences, Introduction to Internet of Behavior (IoB). Self-learning Topics: Internet of Behaviors (IoB) and its role in customer services	04	CO6

Text Book

1. Arsheep Bahga (Author), Vijay Madisetti, Internet Of Things: A Hands-On Approach Paperback, Universities Press, Reprint 2020
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, IoT Fundamentals Networking Technologies, Protocols, and Use Cases for the Internet of Things CISCO.
3. Analytics for the Internet of Things (IoT) Intelligent Analytics for Your Intelligent Devices. Andrew Minter, Packet
4. Giacomo Veneri , Antonio Capasso, " Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0", Packt

References:

1. Pethuru Raj, Anupama C. Raman, The Internet of Things: Enabling Technologies, Platforms, and Use Cases by , CRC press,
2. Raj Kamal, Internet of Things, Architecture and Design Principles, McGraw Hill Education, Reprint 2018.
3. Perry Lea, Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security, Packt Publications, Reprint 2018.
4. Amita Kapoor, "Hands on Artificial intelligence for IoT", 1st Edition, Packt Publishing, 2019.
5. Sheng-Lung Peng, Souvik Pal, Lianfen Huang Editors: Principles of Internet of Things (IoT) Ecosystem: Insight Paradigm, Springer

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Online Resources:

Sr. No.	Website Name
1.	https://owasp.org/www-project-internet-of-things/
2.	NPTEL: Sudip Misra, IIT Khargpur, Introduction to IoT: Part-1, https://nptel.ac.in/courses/106/105/106105166/
3.	NPTEL: Prof. Prabhakar, IISc Bangalore, Design for Internet of Things, https://onlinecourses.nptel.ac.in/noc21_ee85/preview
4.	Mohd Javaid, Abid Haleem, Ravi Pratap Singh, Shanay Rab, Rajiv Suman, Internet of Behaviors (IoB) and its role in customer services, Sensors International, Volume 2, 2021, 100122, ISSN 2666-3511, https://doi.org/10.1016/j.sintl.2021.100122

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL706	Data Science Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ITL706	Data Science Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No	Lab Objectives
1	To apply reasoning for a problem in an uncertain domain.
2	To discuss the solution after building a Cognitive application.
3	To familiarize the students with the basics of Fuzzy Logic and Fuzzy Systems.
4	To familiarize the students with Learning Architectures and Frameworks.
5	To define and apply metrics to measure the performance of various learning algorithms.
6	To enable students to analyze data science methods for real world problems.

Lab Outcomes:

Sr. No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Implement reasoning with uncertainty.	L1, L2, L3
2	Explore use cases of Cognitive Computing	L1, L2
3	Implement a fuzzy controller system.	L1, L2, L3
4	Develop real life applications using learning concepts.	L1, L2, L3
5	Evaluate performance of applications.	L1, L2, L3, L4
6	Implement and analyze applications based on current trends in Data Science.	L1, L2, L3, L4, L5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Hardware & Software requirements:

Hardware Specifications	Software Specifications
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Python, MySQL or Database Software

Prerequisite: Artificial Intelligence and Data Science-I, Python Programming, Data Mining & Business Intelligence.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
I	Uncertainty in AI	1.Implement Inferencing with Bayesian Network in Python	02	LO1
II	Cognitive Computing	2.Building a Cognitive Healthcare application 3.Smarter cities: Cognitive Computing in Government 4.Cognitive computing in Insurance 5.Cognitive computing in Customer Service	04	LO2
III	Fuzzy Logic & Its Applications	6.Implementation of Fuzzy Membership Functions. 7.Implementation of fuzzy set Properties. 8.Design of a Fuzzy control system using Fuzzy tool.	04	LO3
IV	Introduction to Deep Learning	9.Implementing Deep Learning Applications like a. Image Classification System b. Handwritten Digit Recognition System (like MNIST Dataset) c. Traffic Signs Recognition System. d. Image Caption Generator	06	LO4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

V	Advanced ML Classification Techniques	10. Implementation of supervised learning algorithm like a. Ada-Boosting b. Random forests 11. Evaluation of Classification Algorithms.	05	LO4, LO5
VI	Mini-project on trends and applications in Data Science	12. Build text/ image/ video/ audio based DS Applications such as a. Chatbot b. Document Classification c. Sentiment Analysis d. Bounding Box Detection e. Music/Video Genre Classification	05	LO6

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, Pearson Education.
2. Judith S. Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley India, 2015.
3. S.N. Sivanandam, S.N. Deepa, "Principles of Soft Computing", Wiley Publication.
4. Dr. S Lovelyn Rose, Dr. L Ashok Kumar, Dr. D Karthika Renuka, "Deep Learning Using Python", Wiley India, 2020.
5. B. Uma Maheshwari, R. Sujatha, "Introduction to Data Science Practical Approach with R and Python", Wiley India, 2021.
6. François Chollet, "Deep Learning with Python", Manning Publications, 2018.
7. Han J, Kamber M, Pei J, "Data Mining Concepts and Techniques", Third Edition, Morgan Kaufmann.

References:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Publication.
2. Ethem Alpaydin, "Introduction to Machine Learning", PHI Learning Pvt. Ltd.
3. Jon Krohn, Grant Beyleveld, Aglae Bassens, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education.
4. Prateek Joshi, "Artificial Intelligence with Python", Packt Publishing.

Online References:

Sr. No.	Website Links
1	https://wisdomplexus.com/blogs/cognitive-computing-examples/
2	http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning_old/labs/explist.php

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

3	https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01329517021676339249401_shared/overview
4	https://infyspringboard.onwingspan.com/en/app/toc/lex_auth_01329500219268300841860_shared/overview
5	https://www.udemy.com/course/ibm-watson-for-artificial-intelligence-cognitive-computing/

Term Work:

Term Work shall consist of at least 10 practical based on the above list. Also Term Work Journal must include Mini- Project as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 10 Marks (Experiments) + 10 Marks (Mini-project) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Teaching Scheme (Contact hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL707	Internet of Everything Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ITL707	Internet of Everything Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No.	Lab Objectives
The Lab experiments aims:	
1	To learn different types of sensors.
2	To design the problem solution as per the requirement analysis done using sensors.
3	To study the basic concepts of programming/sensors/ emulators.
4	To design and implement the mini project intended solution for project based learning.
5	To build and test the mini project successfully.
6	To improve the team building, communication and management skills of the students.

Lab Outcomes:

Sr. No.	Lab Outcomes	Cognitive Levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify the requirements for the real world problems.	L1,L2
2	Conduct a survey of several available literatures in the preferred field of study.	L1,L2
3	Study and enhance software/ hardware skills.	L1,L2
4	Demonstrate and build the project successfully by hardware/sensor requirements, coding, emulating and testing.	L1,L2,L3
5	To report and present the findings of the study conducted in the preferred domain.	L1,L2,L3,L4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

6	Demonstrate an ability to work in teams and manage the conduct of the research study.	L1,L2,L3,L4

Hardware & Software requirements:

Hardware Specifications	Software Specifications
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk 4. Arduino/ Raspberry Pi kit	Python/C, Conitiki, Cooja or any open source Simulator

Prerequisite: Basics of Java and Python Programming, Devops

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Experimentation with Microprocessor and Microcontroller , Experimentation with python and c	02	
I	Arduino	Introduction to Arduino, Hardware requirements, Software requirements, Arduino Programming Language, Arduino Uno Wired & Wireless connectivity, LCD commands, Serial Communication commands. Program for blinking LED using Arduino. Traffic Light pattern using Arduino. ESP8266 WiFi Module	05	LO1, LO2
II	Raspberry Pi	Introduction to Raspberry Pi, Installation of NOOBS and Raspbian on SD card, Libraries on Raspberry Pi, getting static IP address of Raspberry Pi, Interfacing of Relay, DHT11, DC Motor and LCD with Raspberry Pi.	05	LO1,LO2
III	Contiki OS	Contiki OS : History of Contiki OS, Applications, Features, ,Communication Components in Contiki OS, Cooja simulator ,Running Cooja Simulator,	05	LO3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

IV	Cooja Simulator	Using the Contiki OS with the Cooja simulator to program the IoT for broadcasting data from sensors	03	LO5,LO6
V	Protocols and Security with Cooja	Understanding of 6LowPAN , COAP and protocol implementation in Cooja . Encryption Decryption techniques for IoT	03	LO5,LO6
VI	IoT data to Cloud	Installing the Remote desktop server. Installation of Pi camera, Face recognition, serial peripheral interface using Raspberry Pi. . DHT11 data logger with ThingSpeak/ thingsboard/ AWS/ Azure server .	03	LO4,L06

Text Books:

1. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann
2. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally
3. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. Ovidiu Vermesan, Dr. Peter Friess, River Publishers
4. Internet of Things (A Hands-on-Approach) , Vijay Madiseti , Arshdeep Bahga

References:

1. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley
2. Building the internet of things with ipv6 and mipv6, The Evolving World of M2M Communications, Daniel Minoli John Wiley & Sons
3. Contiki Cooja User Guide.
4. Fundamentals of Sensor Network Programming: Applications and Technology, By S. Sitharama Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley publication.
5. Recent research/white papers

Digital Reference :

1. IoT Analytics -Things<https://thingspeak.com>
2. <https://www.contiki-ng.org/>
3. <http://www.ideationinstru.com/training.html>

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

List of Experiments.

Guidelines for Mini

Project

1. The mini project work is to be conducted by a group of three students
2. Each group will be associated with a subject Incharge/ mini project mentor. The group should meet with the concerned faculty during Laboratory hours and the progress of work discussed must be documented.
3. The students must understand the
 - a. Concept
 - b. Importance
 - c. Interdisciplinary
 - d. Challenges
 - e. Various applications/smart objects
 - f. Major Players/Industry Standards.
4. The students must understand the IoT Architecture:
 - a. Node Structure: Sensing, Processing, Communication, Powering
 - b. Networking: Topologies, Layer/Stack architecture
 - c. Communication Technologies: Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Discuss data rate, range, power, computations/bandwidth, QoS
 - d. Smartness - Signal Processing/Analytics: Impact on Power/Energy savings, dynamic networks, simple case studies
 - e. IoT Fabricator: Introduction to Embedded electronics, fabricating electronics, Communication Network requirements, Data processing challenges – recreation, IP/security, Challenges
 - f. Hands-on in IoT: Projects based on some Hardware (Raspberry pi, Arduino, Intel, IITH Mote, Smartphones), Software (Contiki, TinyOS, Android), IoT Fabricator etc. can be used.
5. The students may visit different websites to identify their IOT topic for the mini project.
6. The students may do surveys for different applications using different types of sensors for their mini project.
7. Each group will identify the Hardware (Motes from different Motes families) & sensor configuration and software requirements for their mini project problem statement.
8. Design your own circuit board using multiple sensors etc.
9. Installation, configure and manage your sensors in such a way so that they can communicate with each other.
10. Work with operating system, emulator like contiki cooja and do coding to for input devices on sensors
11. Create an interface using Mobile/Web to publish or remotely access the data on the Internet.
12. Each group along with the concerned faculty shall identify a potential problem statement, on which the study and implementation is to be conducted.
13. Analyze data collected from different sensors on platform like thinkspeak/AWS/Azure etc
14. Devops and Advance Devops concepts students have learnt in earlier semesters can be used while working with IoT projects.
15. Each group may present their work in various project competitions or paper presentations.
16. A detailed report is to be prepared as per guidelines given by the concerned faculty.



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Term Work:

Term Work shall consist of Mini-Project based on the above syllabus and guidelines. Also Term Work Journal must include at least 2 assignments.

Term Work Marks:

25 Marks (Total marks) = 15 Marks (Mini-Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL708	Secure Application Development	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ITL708	Secure Application Development	--	--	--	--	25	25	50

Lab Objectives:

Sr. No	Lab Objectives
	The Lab experiments aims:
1	To understand the secure programming of application code.
2	To understand the Owasp methodologies and standards.
3	Understand and Identify main vulnerabilities inherent in applications.
4	Understand how Data Validation and Authentication can be applied for application.
5	Understand how to apply Security at Session Layer Management.
6	Understand how to apply to secure coding for cryptography.

Lab Outcomes:

Sr. No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Apply secure programming of application code.	L1,L2,L3
2	Understand the Owasp methodologies and standards.	L1,L2,L3
3	Identify main vulnerabilities inherent in applications.	L1,L2,L3
4	Apply Data Validation and Authentication for application	L1,L2,L3,L4,L5
5	Apply Security at Session Layer Management	L1,L2,L3,L4,L5
6	Apply secure coding for cryptography.	L1,L2,L3,L4,L5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Hardware & Software requirements:

Hardware Specifications	Software Specifications
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Web Application, HTML5, CSS3, Java, C, Python, MySQL or Database Software. Internet Connection, Browser, Security tools. SAST tools etc.

- Prerequisite:** Knowledge of programming languages like java/python/C is required.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Programming Language and Web application basic concepts.	02	
I	Introduction to Secure Programming	Introduction to laws, standards and guidelines of cyber security. What do you mean by attacks, types of attacks and statistics of main vulnerabilities? Lab1: Study of different laws and standards of cyber security.	04	LO1
II	Methodologies for developing secure code	Software Development Lifecycle. Risk Analysis. Threat Modeling. Study different SAST (Static Application Security Testing) tools. Study different top 10 methodologies and guidelines of OWASP (Open Web Application Security Project) for the secure application development. Any top 5 OAT. Best eight guidelines for Secure Coding. Understand the flow of Verification testing for secure coding. Lab2: Case study for SDLC. Lab3: Exercise on Threat Modeling. Lab4: Study of SAST Tools (open Source like GitHub, GitLab and so on) and use at least one for Practical Lab5: Study and implement at least any methodologies of OWASP.	06	LO2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Lab6: Study and implement at least any 5 OAT Denial of Inventory for E-commerce Website..		
III	VAPT of Applications	Introduction to the HTTP protocol. Owasp Web Security Testing Guidelines. Tools for VAPT testing. Lab7: Use Burp proxy to test web applications.	04	LO3
IV	Data Validation & Authentication	Guidelines for input data validation (Data type, Data size, Data range, Data Content etc.) and authentication for login page. Types of Authentication attacks. Study different type of vulnerabilities like SQL Injection vulnerability, LDAP and XPath Injection vulnerabilities, Cross- Site Scripting (XSS) vulnerability, OS Command, LFI/RFI, Unvalidated file upload and buffer overflow etc. Lab8: Registration Page Data Validation. Lab9: SQL injection vulnerability allows login page to bypass. Lab10: LDAP and XPath Injection vulnerabilities for login /registration page. Lab11: Cross-Site Scripting (XSS) vulnerability Lab Lab12: OS Command vulnerability Lab Lab13: LFI/RFI or Unvalidated file upload or Buffer Overflow vulnerability Lab. Lab14: Online Password attack.	05	LO4
V	Security in Session Layer	Introduction to Session Layer in Web Applications and management. Session Management Best practices according to OWASP. Lab15: Session Management for Web Application.	03	LO5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

VI	Secure Coding for cryptography.	Overview of cryptography and guidelines for using encryption. Types of cryptography ie symmetric and asymmetric. Hashing Algorithms etc. Lab16: Symmetric and Asymmetric Lab17: Symmetric Encryption and Hashing.	02	LO6

Text & References Books:

1. Fundamental Practice for Secure Software Development.
2. The OWASP Automated Threat Handbook - Web Applications.
3. OWASP Alpha Release Code Review Guide 2.0
4. Secure Programming HOWTO
5. OWASP Quick reference guide 2.

Online References:

Sr. No.	Website Links
1	https://www.udemy.com/course/secure-coding-secure-application-development/
2	https://kirkpatrickprice.com/blog/secure-coding-best-practices/
3	https://owasp.org/www-project-automated-threats-to-web-applications/assets/oats/EN/OAT-021_Denial_of_Inventory

Term Work:

Term Work shall consist of at least 10 to 12 practical based on the above list. Also Term Work Journal must include at least 2 assignments as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiments) + 5 Marks (Assignment) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL709	Recent Open Source Project Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ITL709	Recent Open Source Project Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr. No	Lab Objectives
The Lab experiments aims:	
1	To understand the basic concepts of Open Source Software.
2	To understand the GPL(General Public Licence) and Contribute of Open Source.
3	To Understand Contribute to Open Source in different Operating System.
4	To Understand Contribute to Open Source in different Technologies.
5	To Understand Contribute to Open Source in different Network Management..
6	To Understand Contribute to Open Source in different Applications and Services.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Lab Outcomes:

Sr. No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand and apply the basic concepts of Open Source Software.	L1,L2,L3
2	Identify the difference between the GPL(General Public Licence) and Contribute to Open Source.	L1,L2,L3
3	Apply and evaluate your knowledge for the Contribute to Open Source in different Operating System.	L1,L2,L3,L4,L5
4	Apply and evaluate your knowledge for the Contribute to Open Source in different Technologies.	L1,L2,L3,L4,L5
5	Apply and evaluate your knowledge for the Contribute to Open Source in different Network Management..	L1,L2,L3,L4,L5
6	Apply and evaluate your knowledge for the Contribute to Open Source in different Applications and Services.	L1,L2,L3,L4,L5

Hardware & Software requirements:

Hardware Specifications	Software Specifications
PC with following Configuration 1. Intel Core i3/i5/i7 2. 4 GB RAM 3. 500 GB Hard disk	Internet Connection. Any Operating System. Any technology open source tools/simulator/emulator. Any open source Testing Tools Any open source Network Monitoring Tools. Any open Source Database tools. Any open source Latex report writing tools.

Prerequisite: OS, Programming Language, DBMS, IP, Network.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Basic Concepts of OS, Programming Language, Network and DMBS.	02	--
I	Introduction to OSS	Overview of OSS. Basic Concepts of OSS. Advantages of OSS. Difference between free and open source software. What is GPL and Contribute to Open Source Project. Different ways to contribute.	04	LO1
II	Contribute to Open Source Project.	Overview of Contribute Open Source Project. Steps or Guidelines of Contribute to Open Source Projects : 1. Why to Contribute to open source Project. 2. What do you mean by Contribute Open Source Projects. 3. Identifying the new/existing open source projects to contribute. 4. Submit your contribute to open source. 5. Results after submitting your contribute to Open Source.	04	LO2
III	Contribute to Open Source in Operating System.	As per Contribute to Operating System to introduce new OS version, Improve OS by removing bugs, Improve existing Skill sets for growth in career. Interact with Stakeholders for feedback and provide training and mentoring. Start own Startup.	04	LO3
IV	Contribute to Open Source in Technologies.	As per Contribute to various emerging technologies like AI/ML/DL/Blockchain/IoT/Data Analytics/Cyber Security/Android/iOS/Flutter/DeVoPs/Virtualization and Cloud Computing etc. To improve technologies. Introduce new version of technologies, Improve technologies by removing bugs, Improve existing Skill sets for growth in career. Interact with Stakeholders and provide training and mentoring. Start own Startup.	04	LO4
V	Contribute to Open Source in Network Management.	As per Contribute to different types of Network and Management Systems like LAN/WAN/MAN/Adhoc	04	LO5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Network/Data Centre/Wireless Network/Enterprise Network etc. To improve Networks as a Network administrator. Design own Network as per customer requirements, Improve existing Skill sets for growth in career. Interact with Stakeholders and provide training and mentoring. Start own Startup		
VI	Contribute to Open Source in Application & Cloud Services.	As per Contribute to various Applications or Case studies using Cloud Services etc. To improve applications, remove bugs. Improve existing Skill sets for growth in career. Interact with Stakeholders and provide training and mentoring. Start own Startup.	04	LO6

Guidelines for Recent Open Source Mini Project as per above syllabus.

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement how to contribute to open source mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of recent contribute to open source mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand contribute to open source problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report using open source tools to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the open source Mini Projects.

Guidelines for Assessment of Recent Open Source Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Text & Reference Books:

1. Forge Your Future with Open Source: Build Your Skills. Build Your Network. Build the Future of Technology. 1st Edition

Online References:

Sr. No.	Website Links
1	https://github.com/freeCodeCamp/how-to-contribute-to-open-source
2	https://opensource.guide/how-to-contribute/#why-contribute-to-open-source

Term Work:

Term Work shall consist of at least Open Source Project based on the above syllabus. Also Term Work Journal must include at least 2 assignments to explain contribute to open source as mentioned in above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Mini-Project) + 5 Marks (Assignment) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the above syllabus.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL710	Major Project – I	--	04	--	--	02	--	02

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	TOTAL				
ITL710	Major Project – I	--	--	--	--	25	25	50

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Major Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of major project-I and major project-II.
- A log book to be prepared by each group, wherein group can record weekly work progress,

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

guide/supervisor can verify and record notes/comments.

- Faculty supervisor may give inputs to students during major project-I & II activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Major Project, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Major Project-I in semester VII and Major Project-II in semesters VIII.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Major Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to Scopus paper publications in Journal/Conference or motivate for Copyright or Indian Patent as an extension of the Major Project-1 with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Major Project:

Term Work

1. The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in each semester VII and VIII.
2. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
3. Distribution of Term work marks for both semesters shall be as below;
 - a. Marks awarded by guide/supervisor based on log book : 10
 - b. Marks awarded by review committee 10
 - c. Quality of Project report 05

Review/progress monitoring committee may consider following points for assessment based on either one year major project as mentioned in general guidelines.

One-year project:

- In semester VII entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalization of problem and proposed solution of the problem
 - Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VIII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
 - First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

- Second review shall be based on paper presentation in conference/journal or copyright or Indian patent in last month of the said semester.

Assessment criteria of Major Project.

Major Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual's as member or leader
13. Clarity in written and oral communication

- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.

Guidelines for Assessment of Major Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Major Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Major Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication
9. Publications in Sem VIII.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Coure Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC731	Storage Area Network	03	--	--	03	--	--	03

Coure Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IA T 1	IAT 2	Total					
ITC731	Storage Area Network	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To provide the knowledge of types Storage Network.
2	To examine NAS technology and its applications in Storage Area Networks.
3	To study Emerging Technologies in SAN.
4	To define backup, recovery, disaster recovery and business continuity in the storage area Network.
5	To learn cloud based storage virtualization technologies in SAN.
6	To understand the logical and physical components of storage infrastructures.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Identify the limitations of the client-server architecture and evaluate the need for data protection and storage centric architectures such as Intelligent storage system.	L1,L2
2	Understand various SAN technologies.	L1,L2
3	Interpret and examine NAS technologies and its application in Storage Area Network.	L1,L2
4	Explain Different I/O Techniques in SAN.	L1,L2
5	Describe Cloud based storage virtualization technologies in SAN.	L1,L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

6	Explain Storage infrastructure management with security.	L1,L2

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Operating System, Computer Organization, Computer Networks.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Components of a Storage System Environment, Disk drive components, RAID levels, Cloud Computing	02	--
I	Introduction to Storage Area Network	Intelligent Storage Systems (ISS) , Storage Provisioning, Types of Intelligent Storage Systems Evolution of Storage System: Server-Centric IT Architecture and its Limitations, Storage-Centric IT Architecture and its Advantages, SAN & its advantages. Self-learning Topics: Case Study on Replacing a server with Storage networks.	04	CO1
II	Networked Attached Storage & its Application	Local File Systems: File systems and databases, Journaling, Snapshots, Volume manager Network File Systems, and File Servers: Network Attached Storage (NAS), Performance bottlenecks in file servers, Acceleration of network file systems, Case study: The Direct Access File System (DAFS), Shared Disk File Systems: A case study The General Parallel File System (GPFS), Applying NAS solution: NAS workload characterization, applying NAS to departmental workloads, enterprise web workloads, and specialized workloads; Considerations when integrating SN and NAS: Differences and similarities, the need to integrate, future storage connectivity and integration. Self-learning Topics: Case study on Successful SAN Deployment steps.	07	CO2



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

III	Storage I/O Techniques	The Physical I/O Path from the CPU to the Storage System, SCSI, The Fibre Channel Protocol Stack, Fibre Channel SAN, IP Storage, Infiniband-based Storage Networks, Fibre Channel over Ethernet (FCoE). Self-learning Topics: Case Study on FCoE SAN.	06	CO3
IV	Backup and Data Archive	Introduction to Business Continuity: Information Availability, BC Terminology, BC Planning Lifecycle, Failure Analysis, Business Impact Analysis Backup and Archive: Backup Purpose, Backup Considerations, Backup Granularity, Recovery Considerations, Backup Methods ,Backup Architecture, Backup and Restore Operations, Backup Topologies Self-learning Topics: Case Study on Replication strategy	06	CO4
V	Storage Area Network as a Service for Cloud Computing & Virtualization	Virtualization and the cloud: Cloud infrastructure virtualization, Cloud platforms, Storage virtualization, SAN virtualization Virtualization Appliances: Black Box Virtualization, In-Band Virtualization Appliances, Out-of-Band Virtualization Appliances High Availability for Virtualization Appliances, Appliances for Mass Consumption. Storage Automation and Virtualization: Policy-Based Storage Management, Application-Aware Storage Virtualization, Virtualization-Aware Applications. Self-learning Topics: Case study on symmetric and asymmetric virtualization in networks.	06	CO5
VI	Securing and Managing storage infrastructure	Securing and Storage Infrastructure: Information Security Framework, Risk Triad, Storage Security Domains, Security Implementations in Storage Networking, Securing Storage Infrastructure in Virtualized and Cloud Environments. Managing the Storage Infrastructure: Monitoring the Storage Infrastructure, Storage Infrastructure Management activities, Storage Infrastructure	08	CO6

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Management Challenges, Information Lifecycle Management, Storage Tiering Self-learning Topics: Case study on SAN Management and Standards.		

Text Books:

1. G. Somasundaram, Alok Shrivastava, EMC Educational Services, “Information Storage and Management”, Wiley India.
2. Storage Virtualization, Author: Clark Tom, Publisher: Addison Wesley Publishing Company
3. Ulf Troppens, Wolfgang Muller-Friedt, Rainer Wolafka, “Storage Networks Explained” Wiley Publication
4. "Introduction to Storage Area Networks" Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel, Libor Miklas, IBM Redbooks.

References:

1. Richard Barker and Paul Massiglia, iStorage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs, Wiley India.
2. Storage Networks: The Complete Reference, by Robert Spalding (Author)
3. “Storage Network Management and Retrieval”, Vaishali Khairnar, Nilima Dongre. Wiley

Online References:

1. <https://www.itprc.com/ultimate-guide-to-storage-area-networks/>
2. <https://www.techtarget.com/searchstorage/definition/storage-area-network-SAN>
3. <https://www.snia.org/educational-library/object-storage-trends-use-cases-2021>
4. <https://www.sciencedirect.com/topics/computer-science/network-attached-storage>
5. <https://www.techtarget.com/searchstorage/tip/Understand-your-storage-infrastructure-management>
6. <https://sites.google.com/site/testwikifirstciscolab/shd/14-securing-the-storage-infrastructure>
7. <https://www.techtarget.com/searchdatabackup/tip/What-is-the-difference-between-archives-and-backups>

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC732	High Performance Computing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC732	High Performance Computing	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	Learn the concepts of high-performance computing.
2	Gain knowledge of platforms for high performance computing.
3	Design and implement algorithms for parallel programming applications.
4	Analyze the performance metrics of High Performance Computing.
5	Understand the parallel programming paradigm, algorithms and applications.
6	Demonstrate the understanding of different High Performance Computing tools.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand fundamentals of parallel Computing.	L1,L2
2	Describe different parallel processing platforms involved in achieving High Performance Computing.	L1,L2,L3
3	Demonstrate the principles of Parallel Algorithms and their execution.	L1,L2,L3
4	Evaluate the performance of HPC systems.	L1,L2,L3,L4
5	Apply HPC programming paradigm to parallel applications.	L1,L2,L3
6	Discuss different current HPC Platforms.	L1,L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Computer Organization, C Programming, Data structures and Algorithm Analysis.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Organization, C Programming, Data structures and Algorithm Analysis.	02	--
I	Introduction	Introduction to Parallel Computing: Motivating Parallelism, Scope of Parallel Computing, Levels of parallelism (instruction, transaction, task, thread, memory, function), Models (SIMD, MIMD, SIMT, SPMD, Dataflow Models, Demand-driven Computation). Self-learning Topics: Parallel Architectures: Interconnection network, Processor Array, Multiprocessor.	05	CO1
II	Parallel Programming Platforms	Parallel Programming Platforms: Implicit Parallelism: Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines. Self-learning Topics: Trends in Microprocessor & Architectures, Limitations of Memory System Performance.	04	CO2
III	Parallel Algorithm And Concurrency	Principles of Parallel Algorithm Design: Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Basic Communication operations: Broadcast and Reduction Communication types. Self-learning Topics: Parallel Algorithm Models	09	CO3
IV	Performance Measures for HPC	Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law. Self-learning Topics: Performance Bottlenecks.	05	CO4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

V	Programming Paradigms for HPC	Programming Using the Message-Passing Paradigm : Principles of Message Passing Programming, The Building Blocks: Send and Receive Operations, MPI: the Message Passing Interface, Topology and Embedding. Parallel Algorithms and Applications : One-Dimensional Matrix-Vector Multiplication, Graph Algorithms, Sample Sort, Two-Dimensional Matrix Vector Multiplication. Self-learning Topics: Introduction to OpenMP.	09	CO5
VI	General Purpose Graphics Processing Unit(GPGPU) Architecture and Programming	OpenCL Device Architectures, Introduction to OpenCL Programming. Self-learning Topics: Introduction to CUDA architecture, and Introduction to CUDA Programming	05	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar , “Introduction to Parallel Computing”, Pearson Education, Second Edition, 2007.
2. Kai Hwang, Naresh Jotwani, “Advanced Computer Architecture: Parallelism, Scalability, Programmability”, McGraw Hill, Second Edition, 2010.
3. Edward Kandrot and Jason Sanders, “CUDA by Example – An Introduction to General Purpose GPU Programming”, Addison-Wesley Professional ©, 2010.
4. Georg Hager, Gerhard Wellein, “Introduction to High Performance Computing for Scientists and Engineers”, Chapman & Hall / CRC Computational Science series, 2011.
5. Benedict Gaster, Lee Howes, David Kaeli, Perhaad Mistry, Dana Schaa , “Heterogeneous Computing with OpenCL” , 2nd Edition, Elsevier, 2012.

References Books:

1. Michael J. Quinn, “Parallel Programming in C with MPI and OpenMP”, McGraw-Hill International Editions, Computer Science Series, 2008.
2. Kai Hwang, Zhiwei Xu, “Scalable Parallel Computing: Technology, Architecture, Programming”, McGraw Hill, 1998.
3. Laurence T. Yang, MinyiGuo, “High- Performance Computing: Paradigm and Infrastructure” Wiley, 2006.
4. Fayez Gebali, “Algorithms and Parallel Computing”, John Wiley & Sons, Inc., 2011.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc21_cs46/preview
2.	https://onlinecourses.nptel.ac.in/noc22_cs21/preview

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC733	Infrastructure Security	03	--	-	03	--	-	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC733	Infrastructure Security	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To understand underlying principles of infrastructure security.
2	To explore software vulnerabilities, attacks and protection mechanisms to learn security aspects of wireless network infrastructure and protocols.
3	To investigate web server vulnerabilities and their countermeasures.
4	To investigate cloud infrastructure vulnerabilities and their countermeasures.
5	To learn the different attacks on Open Web Applications and Web services.
6	To learn the different security policies.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Understand the concept of vulnerabilities, attacks and protection mechanisms.	L1,L2
2	Analyze and evaluate software vulnerabilities and attacks on databases and operating systems.	L1,L2,L3
3	Explain the need for security protocols in the context of wireless communication.	L1,L2,L3
4	Understand and explain various security solutions for Cloud infrastructure.	L1,L2
5	Understand and evaluate different attacks on open web application and web-services.	L1,L2
6	Design appropriate security policies to protect infrastructure components.	L1,L2,L3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 /45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Computer Networks, Cryptography and Network Security

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic of OSI Model, Topology's and Computer Networks, Cryptography and Network Security.	02	--
I	Introduction	Cyber-attacks, Vulnerabilities, Defense Strategies and Techniques, Authentication Methods- Password, Token and Biometric, Access Control Policies and Models (DAC,MAC, RBAC, ABAC, BIBA, Bell La Padula), Self-Learning Topics: Authentication and Access Control Services- RADIUS, TACACS, and TACACS+	04	CO1
II	Software Security	Software Vulnerabilities: Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, Malware: Viruses, Worms, Trojans, Logic Bomb, Bots, Rootkits Operating System Security: Memory and Address Protection, File Protection Mechanism, User Authentication. Database Security: Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security Self-Learning Topics: Format String, File System Security (Windows and Linux OS)	08	CO2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

III	Wireless Security	Mobile Device Security- Security Threats, Device Security, IEEE 802.11xWireless LAN Security, VPN Security, Wireless Intrusion Detection System (WIDS) Self-Learning Topics: Wireshark, Cain and Abel, Aircrack.	06	CO3
IV	Cloud Security	Cloud Security Risks and Countermeasures, Data Protection in Cloud, Cloud Application Security, Cloud Identity and Access Management, Cloud Security as a Service. Self-Learning Topics: Metasploit, Ettercap.	06	CO4
V	Web Security	Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross- Site Request Forgery, Session Hijacking and Management, Phishing and Pharming Techniques, DNS Attacks, Web Service Security, Secure Electronic Transaction, Email Attacks, Web Server Security as per OWASP, Firewalls. Self-Learning Topics: Penetration Testing tools: SQL Map, Wapiti.	08	CO5
VI	Information Security and Risk Management	Security Policies, Business Continuity Plan, Risk Analysis, Incident Management, Legal System and Cybercrime, Ethical Issues in Security Management. Self-Learning Topics: The Indian IT Act, Indian Cyber Law	05	CO6

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Text Books:

1. Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education
3. Network Security and Cryptography, Bernard Menezes, Cengage Learning
4. Network Security Bible, Eric Cole, Second Edition, Wiley

References Books:

1. Web Application Hackers Handbook by Wiley.
2. Computer Security, Dieter Gollman, Third Edition, Wiley
3. CCNA Security Study Guide, Tim Boyle, Wiley
4. Introduction to Computer Security, Matt Bishop, Pearson.
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif , O'Riely
6. Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi

Online References:

1. <https://www.cousera.org>
2. <https://nptel.ac.in>

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC734	Software Testing and QA	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC734	Software Testing and QA	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives	
The course aims:		
1	To provide students with knowledge in Software Testing techniques.	
2	To provide knowledge of Black Box and White Box testing techniques.	
3	To provide skills to design test case plans for testing software.	
4	To prepare test plans and schedules for testing projects.	
5	To understand how testing methods can be used in a specialized environment.	
6	To understand how testing methods can be used as an effective tool in providing quality assurance concerning software.	
Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.	L1, L2, L3
2	Understand various software testing methods and strategies.	L1, L2
3	Manage the testing process and testing metrics.	L1, L2, L3
4	Understand fundamental concepts of software automation and use automation tools.	L1, L2
5	Apply the software testing techniques in the real time environment.	L1, L2, L3
6	Use practical knowledge of a variety of ways to test software and quality attributes.	L1, L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Programming Language (C++, Java), Software Engineering

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Software Engineering Concepts, Basics of programming Language	02	
I	Testing Methodology	Introduction, Goals of Software Testing, Software Testing Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies, Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology, Verification and Validation, Verification requirements, Verification of high level design, Verification of low level design, validation. Self-learning Topics: Study any system/application, find requirement specifications and design the system. Select software testing methodology suitable to the application.	07	CO1
II	Testing Techniques	Dynamic Testing: Black Box Testing: Boundary Value Analysis, Equivalence Class Testing, State Table Based testing, Cause-Effect Graphing Based Testing, Error Guessing. White Box Testing Techniques: need, Logic Coverage Criteria, Basis Path Testing, Graph Matrices, Loop Testing, Data Flow testing, Mutation testing. Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing. Regression Testing: Progressive vs. Regressive, Regression Testing, Regression Testability, Objectives of Regression Testing, Regression Testing Types, Define Problem, Regression Testing Techniques. Self-learning Topics: Select the test cases (positive and negative scenarios) for the selected system and	09	CO2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Design Test cases for the system using any two studied testing techniques.		
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test Specification. Software Metrics: need, definition and Classification of software matrices. Testing Metrics for Monitoring and Controlling the Testing Process: attributes and corresponding metrics, estimation model for testing effort, architectural design, information flow matrix used for testing, function point and test point analysis. Efficient Test Suite Management: minimizing the test suite and its benefits, test suite minimization problem, test suite prioritization its type , techniques and measuring effectiveness. Self-learning Topics: Design quality matrix for your selected system	08	CO3
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, guidelines for testing tools. Study of testing tools: JIRA, Bugzilla, TestDirector and IBM Rational Functional Tester, Selenium etc. Self-learning Topics: Write down test cases, execute and manage using studied tools	05	CO4



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

V	Testing for specialized environment	Agile Testing, Agile Testing Life Cycle, Testing in Scrum phases, Challenges in Agile Testing Testing Web based Systems: Web based system, web technology evaluation, traditional software and web based software, challenges in testing for web based software, testing web based testing Self-learning Topics: Study the recent technical papers on software testing for upcoming technologies (Mobile, Cloud, Blockchain, IoT)	04	CO5
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria, ISO9000:2000, SIX sigma, Software quality management Self-learning Topics: Case Studies to Identify Quality Attributes Relationships for different types of Applications (Web based, Mobile based etc.)	04	CO6

Text Books:

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher Education
2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

References Books:

1. Effective Methods for Software Testing , third edition by Willam E. Perry,
Wiley Publication
2. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , Dreamtech press

Online References:

1. www.swayam.gov.in
2. www.coursera.org
3. [http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1099-1689](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1689)
4. https://onlinecourses.nptel.ac.in/noc17_cs32/preview
5. https://www.youtube.com/channel/UC8w8_H_1uDfi2ftQx7a64uQ

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC741	Mobile Ad-hoc Network	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC742	Mobile Ad-hoc Network	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To identify and distinguish major issues associated with ad-hoc networks.
2	To analyze the basic concepts for designing a routing protocol for MANETs.
3	To explore and analyze routing protocols of Ad-hoc network.
4	To learn the concepts of Transport layer and Security issues for MANETs.
5	To apply fundamental principles characteristics of QoS and understand the need of Energy Management in wireless ad-hoc network.
6	To learn the basic concepts of Sensor Networks for Communication in Mobile Ad-hoc network.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the fundamentals of Mobile ad-hoc Networks.	L1,L2
2	Understand and be able to use advanced concept of MAC layer protocols more effectively.	L1,L2
3	Analyse different routing technologies for designing a routing protocol.	L1,L2,L3,L4
4	Understand the concepts of Transport layer and security features of Ad-hoc network.	L1,L2
5	Create the awareness of QoS and Energy Management in Ad hoc network.	L6
6	Demonstrate the ability of wireless sensor network.	L2,L3,L4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Wireless Technology.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of Wireless Communication, Wireless Metropolitan and Local Area Networks: IEEE 802.16 (WiMax) – Mesh mode, IEEE 802.11(Wi-Fi) – Architecture, Wireless Ad hoc Networks: WPAN Device Architecture, Wireless Sensor Network Applications, Advantages and Limitations, Wireless Network Security: Security in GSM; UMTS Security; Bluetooth Security; WEP.	02	--
I	Introduction to Ad-hoc Wireless Networks	Introduction: Cellular and Ad Hoc Wireless Networks, Applications of Ad Hoc Wireless Networks, Issues In Ad Hoc Wireless Networks: Medium Access Scheme, Routing, Multicasting, Transport Layer Protocols, Pricing, Quality of Service Provisioning, Addressing and Service Discovery, Energy Management, Scalability, Deployment Considerations, Ad Hoc Wireless Internet Self-learning Topics: Global Mobile Ad Hoc Network Market	05	CO1
II	Medium Access Control Protocols	Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols with Reservation Mechanisms and Scheduling Mechanisms, IEEE 802.11a and HiperLan standard Self-learning Topics: MAC Protocols that use Directional Antennas and Other MAC Protocols	07	CO2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

III	Routing Protocols	Routing Protocols in Ad-hoc Wireless Networks: Introduction, Design issues, Classification of Routing Protocols: Routing information update mechanism, Use of temporal information for routing, Routing topology, Utilization of specific resources, Multicast Routing in Ad-hoc Wireless Networks: Introduction, Design Issues, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols Self-learning Topics: Table Driven Routing Protocols, Classifications of Multicast Routing Protocols	08	CO3
IV	Transport Layer and Security Protocols	Transport Layer in Ad-hoc Wireless Networks: Introduction, Design Issues and Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions. Security in Ad-hoc Wireless Networks: Issues and Challenges in Security Provisioning, Network Security Attacks classification. Self-learning Topics: TCP over Transport Layer Solutions, Key Management and Secure Routing	07	CO4
V	Quality of Service and Energy Management	Quality of Service in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes Self-learning Topics: MAC Layer Solutions Battery Management Schemes	06	CO5
VI	Wireless Sensor Networks	Introduction, Sensor Network Architecture, Data Dissemination, Data Gathering Self-learning Topics: Location Discovery and Quality of a Sensor Network	04	CO6



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Text Books:

1. C. S. Ram Murthy, B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols", Prentice Hall of India, 2nd Edition, 2005
2. C. K. Toh, "Adhoc Mobile Wireless Networks", Pearson Education, 2002
3. Wireless Communications & Networks, By William Stallings, Second Edition, Pearson Education

References Books:

1. Shih-Lin Wu Yu-Chee Tseng, "Wireless Ad Hoc Networking: Personal-Area, Local-Area, and the Sensory-Area Networks", Auerbach Publications, 2007
2. Subir Kumar Sarkar, "Adhoc Mobile Wireless Network: Principles, Protocols and Applications" CRC Press
3. Prashant Mohapatra and Sriramamurthy, "Ad Hoc Networks: Technologies and Protocols", Springer International Edition, 2009

Online References:

1. <https://www.cousera.org>
2. <https://nptel.ac.in>

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC742	ARVR	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC742	ARVR	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To understand the concepts of Augmented Reality and related technologies.
2	To understand the AR tracking system and use of computer vision in AR/MR.
3	To describe the technology for multimodal user interaction and authoring in AR.
4	To understand primitives of computer graphics fundamental.
5	To analyze various Hardware devices suitable for VR.
6	To analyze visual physiology and issues related to it.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and compare different Augmented Reality and Mixed Reality Technologies.	L1, L2
2	Apply concepts of Computer Vision for tracking in AR and MR Systems.	L3
3	Model different interfaces and authoring in AR/MR.	L3
4	Solve Computer Graphics Problems.	L1
5	Analyze application of VR hardware and software components.	L1, L2, L3
6	Identify issues related to visual physiology.	L1, L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Programming Language, Computer Graphics, Virtual Reality

DETAILED SYLLABUS:

Module	Title	Description	Hours	CO
0	Pre-requisite	Basics of Computer Graphics, Coordinate Systems, VR Introduction, Tracking in VR	02	--
I	Introduction to Augmented Reality and Mixed Reality	Definition and Scope, A Brief History of Augmented Reality, AR Architecture, Related Fields of AR (like Mixed Reality, Virtual Reality, Immersive Reality, Extended Reality) and Their comparison, General Architecture of Mixed Reality System, Algorithm Steps in Mixed Reality Self-Learning Topics: How AR/MR are related to Ubiquitous Computing, Multidimensional Systems.	04	CO1
II	Tracking and Computer Vision for AR and MR	Multimodal Displays; Visual Perception; Spatial Display Model; Visual Displays; Tracking, Calibration and Registration; Coordinate Systems; Characteristics of Tracking Technology; Stationary Tracking Systems; Mobile Sensors; Optical Tracking; Sensor Fusion; Marker Tracking; Multiple Camera Infrared Tracking; Natural Feature Tracking by Detection; Incremental Tracking; Simultaneous Localization and Tracking; Outdoor Tracking Self-Learning Topics: Indoor Tracking, Full Body Tracking	06	CO2
III	Interaction, Modeling and Annotation and Authoring	Output Modalities, Input Modalities, Tangible Interfaces, Virtual User Interfaces on Real Surfaces, Multi-view Interfaces, Haptic Interaction, Multimodal Interaction, Specifying Geometry, Specifying Appearance, Semi-automatic Reconstruction, Free-form Modeling, Annotation, Requirement of AR Authoring, Elements of Authoring, Stand-alone Authoring Solutions, Plug-in Approaches, Web Technology Self-Learning Topics: Case Study on Object Annotation in Real Time, Avatar Modeling.	06	CO3
IV	Geometry of Virtual World	Geometric Modeling, 2D transformations, Homogenous coordinate system, 3D rotation and 6 degree of freedom, Viewport Transformation Self: Eye Transformation, demo of 2D transformation	08	CO4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

V	Introduction to VR	Introduction to VR and definitions and its components., Hardware components: Display devices: LCD, OLED Audio: Speakers, Earphones, Bone conduction Touch: Haptic Device GPU and CPU, Input devices like game controller, data gloves, Joysticks Tracking Hardware: Industrial measurement Unit-IMU, Gyroscope, accelerometer Software component: Java3D, VRML Self: Feedback mechanisms in VR environment	07	CO5
VI	Visual Physiology, perception and tracking	Functioning of Eye with photoreceptors, Resolution for VR, Eye movements and issues with it in VR, Neuroscience of vision, Depth and motion perception, Frame rates and display, Orientation tracking, tilt and yaw drift correction, Tracking with camera Self: Light House approach	06	CO6

Textbooks:

1. Dieter Schmalstieg and Tobias Hollerer, “Augmented Reality- Principles and Practice”, Pearson Education, Inc. 2016 Edition.
2. Chetankumar G Shetty, “Augmented Reality- Theory, Design and Development”, Mc Graw Hill, 2020 Edition.
3. Alan B. Craig, “Understanding Augmented Reality – Concepts and Applications”, Morgan Kaufmann, Elsevier, 2013 Edition.
4. Hearn and Baker, “Computer Graphics- C version”, 2nd edition, Pearson, 2002.
5. R. K Maurya, “Computer Graphics with Virtual Reality”, 3rd Edition, Wiley India, 2018.
6. Steven M. LaVelle, “Virtual Reality”, Cambridge University press, 2019
7. Grigore Burdea, Philippe Coiffet, “Virtual Reality Technology”, 2nd Edition, Wiley India, 2003
8. Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002

References Books:

1. Borko Furht, “Handbook of Augmented Reality”, Springer, 2011 Edition.
2. Erin Pangilinan, Steve Lukas, and Vasanth Mohan, “Creating Augmented and Virtual Realities- Theory and Practice for Next-Generation Spatial Computing”, O’Reilly Media, Inc., 2019 Edition.
3. Jens Grubert, Dr. Raphael Grasset, “Augmented Reality for Android Application Development”, PACKT Publishing, 2013 Edition.
4. George Mather, “Foundations of Sensation and Perception”, Psychology Press book; 3rd Edition, 2016
5. Tony Parisi, “Learning Virtual Reality”, 1st edition, O’Reilly, 2015
6. Alan Craig and William Sherman, “Understanding virtual reality: Interface, application and design”, 2nd Edition, Morgan Kaufmann Publisher, 2019
7. Peter Shirley, Michael Ashikhmin, and Steve Marschner, “Fundamentals of Computer Graphics”, A K Peters/CRC Press; 4th Edition, 2016.

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Online Resources:

Sr. No.	Website Name
1.	www.nptel.ac.in
2.	www.coursera.org
3.	https://nptel.ac.in/courses/121/106/121106013/#
4.	http://msl.cs.uiuc.edu/vr/
5.	http://lavalle.pl/vr/

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 📧 slrtce@rahuleducation.com 🌐 www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC743	Quantum Computing	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC744	Quantum Computing	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
	The course aims:
1	To know the fundamentals of Quantum computing and its applications.
2	To understand the efficient quantum algorithms for several basic promise problems.
3	To gain knowledge about quantum computers and their principles.
4	To understand the principles, quantum information and limitation of quantum operations formalizing.
5	To gain knowledge about different quantum error and its correction techniques.
6	To gain knowledge about different quantum cryptographic algorithms.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
	On successful completion, of course, learner/student will be able to:	
1	Basics of Quantum computing and its applications.	L1,L2
2	Solve various problems using quantum algorithms.	L1,L2
3	Methodology for quantum computers and their principles.	L1,L2,L3
4	Comprehend quantum noise and operations.	L1,L2,L3
5	Gain knowledge about different quantum error correction techniques.	L1,L2,L3
6	To gain knowledge about different quantum cryptographic algorithms.	L1,L2,L3

Prerequisite: NA

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
I	FUNDAMENTALS OF QUANTUM COMPUTING	Fundamental Concepts: Introduction and Overview – Global Perspectives – Quantum Bits – Quantum Computation – Quantum Algorithms – Experimental Quantum Information Processing – Quantum Information. Problems on Qubits Self-learning Topics: Detail of Quantum computing and its applications https://www.ibm.com/quantum-computing/what-is-quantum-computing/	07	CO1
II	QUANTUM COMPUTATION	Quantum Circuits – Quantum algorithms, Single Orbit operations, Control Operations, Measurement, Universal Quantum Gates, Simulation of Quantum Systems, Quantum Fourier transform, Phase estimation, Applications, Quantum search algorithms – Quantum counting – Speeding up the solution of NP – complete problems – Quantum Search for an unstructured database. Problems on Boolean functions and Quantum gates, Quantum gates and circuits. Self-learning Topics: Application of Quantum Computing	08	CO2
III	QUANTUM COMPUTERS	Guiding Principles, Conditions for Quantum Computation, Harmonic Oscillator Quantum Computer, Optical Photon Quantum Computer – Optical cavity Quantum electrodynamics, Ion traps, Nuclear Magnetic resonance. Self-learning Topics: Qiskit	06	CO3
IV	QUANTUM INFORMATION S	Quantum noise and Quantum Operations – Classical Noise and Markov Processes, Quantum Operations, Examples of Quantum noise and Quantum Operations – Applications of Quantum operations, Limitations of the Quantum operations formalism, Distance Measures for Quantum information. Problems on Measurement Self-learning Topics: Case study on Quantum noise and operations.	07	CO4
V	QUANTUM ERROR CORRECTION	Introduction, Shor code, Theory of Quantum Error – Correction, Constructing Quantum Codes, Stabilizer codes, Fault – Tolerant Quantum Computation. Self-learning Topics: Case study on Quantum error correction.	05	CO5
VI	QUANTUM CRYPTOGRAPHY	Quantum Cryptography-Private Key Cryptography, Privacy Amplification and Information Reconciliation, Quantum Key Distribution, Privacy and Coherent Information, The Security of Quantum Key Distribution.	06	CO6

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Problems on Quantum error correction and cryptography. Self-learning Topics: Attacks on Quantum Cryptography		

Text Books:

1. Chris Bernhardt, "Quantum Computing for Everyone", (The MIT Press) Hardcover – Illustrate ,September 2020,
2. Willi-Hans Steeb; "Problems and Solutions in Quantum Computing and Quantum Information", Yorick Hardy Academic Consulting and Editorial Services (ACES) Private Limited, January 2020.
3. M.A. Nielsen and I.Chuang, "Quantum Computation and Quantum Information", Cambridge University Press 2010.

References Books:

1. Computer Science: An Introduction by N. David Mermin 5. Yanofsky's and Mannucci, Quantum Computing for Computer Scientists.
2. Parag K. Lala ,Quantum Computing: A Beginner's Introduction Paperback", McGraw Hill November 2020.
3. V. Sahni, "Quantum Computing", Tata McGraw-Hill Publishing company, 2007.
4. Nayak, Chetan; Simon, Steven; Stern, Ady; Das Sarma, Sankar, "Nonabelian Anyons and Quantum Computation", 2008.

Online References:

1. <https://www.coursera.org>
2. <https://nptel.ac.in>



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC744	Information Retrieval System	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Tot. of 2 Tests					
ITC744	Information Retrieval System	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
The course aims:	
1	To learn the fundamentals of the information retrieval system.
2	To classify various Information retrieval models.
3	To demonstrate the query processing techniques and operations.
4	To compare the relevance of query languages for text and multimedia data.
5	To evaluate the significance of various indexing and searching techniques for information retrieval.
6	To develop an effective user interface for information retrieval.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Define and describe the objectives of the basic concepts of the Information retrieval system.	L1,L2
2	Evaluate the taxonomy of different information retrieval models.	L1,L2,L3,L4
3	Try to solve and process text and multimedia retrieval queries and their operations.	L1,L2
4	Evaluate text processing techniques and operations in the information retrieval system.	L1,L2,L3,L4
5	Demonstrate and evaluate various indexing and searching techniques.	L1,L2,L3,L4
6	Design the user interface for an information retrieval system.	L1,L2,L3,L4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Prerequisite: Data Structures

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Indexing and searching Algorithms	02	
I	Introduction	Motivation, Basic Concepts, The Retrieval Process, Information System: Components, parts and types on information system; Definition and objectives on information retrieval system, Information versus Data Retrieval. Search Engines and browsers Self-learning Topics: Search Engines, Search API	06	CO1
II	IR Models	Modeling: Taxonomy of Information Retrieval Models, Retrieval: Formal Characteristics of IR models, Classic Information Retrieval, Alternative Set Theoretic models, Probabilistic Models, Structured text retrieval Models, models for Browsing; Self-learning Topics: Terrier	06	CO2
III	Query Processing and Operations	Query Languages: Keyword based Querying, Pattern Matching, Structural Queries, Query Protocols; Query Operations: User relevance feedback, Multimedia IR models: Data Modeling Self-learning Topics: Proximity Queries and Wildcard Queries	06	CO3
IV	Text Processing	Text and Multimedia languages and properties: Metadata, Markup Languages, Multimedia; Text Operations: Document Preprocessing, Document Clustering. Self-learning Topics: Digital Library : Greenstone	06	CO4
V	Indexing and Searching	Inverted files, Other indices for text, Boolean Queries, Sequential Searching, Pattern Matching, Structural Queries, Compression; Multimedia IR: Indexing and Searching:- A Generic Multimedia indexing approach, Automatic Feature extraction; Searching Web: Challenges, Characterizing the web, Search Engines. Browsing, Meta searches, Searching using Hyperlinks. Self-learning Topics: Koha	07	CO5

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

VI	User interface and visualization	Human Computer interaction, the information access process, starting points, query specifications, context, using relevance judgments, interface support for the search process. Self-learning Topics: SeeSoft	06	CO6

Text Books:

1. Modern Information Retrieval, Ricardo Baeza-Yates,berthier Ribeiro- Neto, ACM Press- Addison Wesley
2. Information Retrieval Systems: Theory and Implementation, Gerald Kowaski, Kluwer Academic Publisher
3. Storage Network Management and Retrieval by Dr. Vaishali Khairnar, Nilima Dongre, Wiley India.

References Books:

1. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press.
2. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons
3. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman.

Online References:

1. <https://www.geeksforgeeks.org/what-is-information-retrieval/>
2. <https://nlp.stanford.edu/IR-book/>
3. https://en.wikipedia.org/wiki/Information_retrieval
4. <https://people.ischool.berkeley.edu/~hearst/irbook/10/node1.html>



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
 Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
 DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OE7501	Product Life Cycle Management	03

Course Objectives: Students will try :

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to :

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM):Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies:Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

02	Product Design: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment,Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

REFERENCES:

- 1 John Stark, "Product Lifecycle Management: Paradigm for 21st Century Product Realisation", Springer- Verlag, 2004. ISBN: 1852338105
- 2 Fabio Giudice, Guido La Rosa, Antonino Risitano, "Product Design for the environment-A life cycle approach", Taylor & Francis 2006, ISBN: 0849327229
- 3 Saaksvuori Antti, Immonen Anselmie, "Product Life Cycle Management", Springer, Dreamtech, ISBN: 3540257314
- 4 Michael Grieve, "Product Lifecycle Management: Driving the next generation of lean thinking", Tata McGraw Hill, 2006, ISBN: 0070636265

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OE7502	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08
03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

REFERENCES:

- 1 L.S. Srinath, "Reliability Engineering", Affiliated East-West Press (P) Ltd., 1985.
- 2 Charles E. Ebeling, "Reliability and Maintainability Engineering", Tata McGraw Hill.
- 3 B.S. Dhillon, C. Singh, "Engineering Reliability", John Wiley & Sons, 1980.
- 4 P.D.T. Connor, "Practical Reliability Engg.", John Wiley & Sons, 1985.
- 5 K.C. Kapur, L.R. Lamberson, "Reliability in Engineering Design", John Wiley & Sons.
- 6 Murray R. Spiegel, "Probability and Statistics", Tata McGraw-Hill Publishing Co. Ltd.



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
 Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
 DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OE7503	Management Information System	03

Objectives:

1. The course is blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7
04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 | slrtce@rahuleducation.com | www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

REFERENCES:

1. Kelly Rainer, Brad Prince, Management Information Systems, Wiley
2. K.C. Laudon and J.P. Laudon, Management Information Systems: Managing the Digital Firm, 10th Ed., Prentice Hall, 2007.
3. D. Boddy, A. Boonstra, Managing Information Systems: Strategy and Organization, Prentice Hall, 2008



Shree Rahul Education Society's (Regd.)
SHREE L. R. TIWARI
COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OE7504	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

Module	Detailed Contents	Hrs
01	Introduction Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06
02	Fitting Regression Models Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

03	Two-Level Factorial Designs The 2^2 Design The 2^3 Design The General 2^k Design A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07
05	Response Surface Methods and Designs Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07
06	Taguchi Approach Crossed Array Designs and Signal- to-Noise Ratios Analysis Methods Robust design examples	04

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Shree Rahul Education Society's (Regd.)

SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai.

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

REFERENCES:

1. Raymond H. Mayers, Douglas C. Montgomery, Christine M. Anderson-Cook, Response Surface Methodology: Process and Product Optimization using Designed Experiment, 3rd edition, John Wiley & Sons, New York, 2001
2. D.C. Montgomery, Design and Analysis of Experiments, 5th edition, John Wiley & Sons, New York, 2001
3. George E P Box, J Stuart Hunter, William G Hunter, Statics for Experimenters: Design, Innovation and Discovery, 2nd Ed. Wiley
4. W J Dimond, Peactical Experiment Designs for Engineers and Scintists, John Wiley and Sons Inc. ISBN: 0-471-39054-2
5. Design and Analysis of Experiments (Springer text in Statistics), Springer by A.M. Dean, and D. T.Voss



Course Code	Course Name	Credits
OECE7505	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality, Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method. Assignment Problem: Introduction, Mathematical Formulation of the Problem, Hungarian Method Algorithm, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem Routing Problem, Travelling Salesman Problem	14



R-2025- B.E INFORMATION TECHNOLOGY

	Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.	
02	Queuing models: queuing systems and structures, single server and multi- server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05



REFERENCES:

6. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
7. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Willey and Sons, 2nd Edition, 2009.
8. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
9. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut.
10. Operations Research, KantiSwarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons.



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OE7506	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyber line Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms, Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	6



R-2025- B.E INFORMATION TECHNOLOGY

04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6

REFERENCES:

- 1 Nina Godbole, Sunit Belapure, *Cyber Security*, Wiley India, New Delhi
- 2 The Indian Cyber Law by Suresh T. Vishwanathan; Bharat Law House New Delhi
- 3 The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
- 4 Cyber Law & Cyber Crimes By Advocate Prashant Mali; Snow White Publications, Mumbai
- 5 Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
- 6 Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.
- 7 William Stallings, *Cryptography and Network Security*, Pearson Publication
- 8 Websites for more information is available on : The Information Technology ACT, 2008- TIFR : <https://www.tifrh.res.in>
- 9 Website for more information , A Compliance Primer for IT professional : <https://www.sans.org/reading-room/whitepapers/compliance/compliance-primer-professionals-33538>



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OEC7507	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction 1.1 Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09



R-2025- B.E INFORMATION TECHNOLOGY

03	Disaster Management, Policy and Administration Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: 4.1 Importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority (NDMA) in India. Methods and measures to avoid disasters, Management of casualties, set up of emergency facilities, importance of effective communication amongst different agencies in such situations. 4.2 Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06
05	Financing Relief Measures: Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06

REFERENCES:

- 1 'Disaster Management' by Harsh K. Gupta, Universities Press Publications.
- 2 'Disaster Management: An Appraisal of Institutional Mechanisms in India' by O.S. Dagur, published by Centre for land warfare studies, New Delhi, 2011.
- 3 'Introduction to International Disaster Management' by Damon Copolla, Butterworth Heinemann Elsevier Publications.
- 4 'Disaster Management Handbook' by Jack Pinkowski, CRC Press Taylor and Francis group.



R-2025- B.E INFORMATION TECHNOLOGY

- 5 'Disaster management & rehabilitation' by Rajdeep Dasgupta, Mittal Publications, New Delhi.
- 6 'Natural Hazards and Disaster Management, Vulnerability and Mitigation – R B Singh, Rawat Publications
- 7 Concepts and Techniques of GIS –C.P.Lo Albert, K.W. Yonng – Prentice Hall (India) Publications. (Learners are expected to refer reports published at national and International level and updated information available on authentic web sites)



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OEC7508	Energy Audit and Management	03

Objectives:

1. To understand the importance energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act-2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04
02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08



R-2025- B.E INFORMATION TECHNOLOGY

03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipments and appliances, star ratings. Energy efficiency measures in lighting system, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03



REFERENCES:

11. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
12. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
13. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
14. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
15. Energy Management Principles, C.B.Smith, Pergamon Press
16. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
17. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
18. www.energymanagertraining.com
19. www.bee-india.nic.in



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OEC7509	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Demonstrate understanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans and Rural Development; Planning process at National, State, Regional and District levels; Planning, development, implementing and monitoring organizations and agencies; Urban and rural interface - integrated approach and local plans; Development	07



R-2025- B.E INFORMATION TECHNOLOGY

	initiatives and their convergence; Special component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions - organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

Reference

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rdGoI, New Delhi Amendment) Act, GoI, New Delhi
4. Planning Commission, Five Year Plans, Planning Commission
5. Planning Commission, Manual of Integrated District Planning, 2006, Planning Commission New Delhi
6. Planning Guide to Beginners.

B.E Syllabus

SEM 8



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC801	Blockchain and DLT	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC801	Blockchain and DLT	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	To get acquainted with the concept of Distributed ledger system and Blockchain.
2	To learn the concepts of consensus and mining in Blockchain through the Bitcoin network.
3	To understand Ethereum and develop-deploy smart contracts using different tools and frameworks.
4	To understand permissioned Blockchain and explore Hyperledger Fabric.
5	To understand different types of crypto assets.
6	To apply Blockchain for different domains IOT, AI and Cyber Security.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Describe the basic concept of Blockchain and Distributed Ledger Technology.	L1,L2
2	Interpret the knowledge of the Bitcoin network, nodes, keys, wallets and transactions	L1,L2,L3
3	Implement smart contracts in Ethereum using different development frameworks.	L1,L2,L3
4	Develop applications in permissioned Hyperledger Fabric network.	L1,L2,L3
5	Interpret different Crypto assets and Crypto currencies	L1,L2,L3
6	Analyze the use of Blockchain with AI, IoT and Cyber Security using case studies.	L1,L2,L3,L4

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



Prerequisite: Cryptography and Distributed Systems.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content		CO Mapping
0	Cryptography and Distributed Systems (prerequisite)	Hash functions, Public – Private keys, SHA, ECC, Digital signatures, Fundamental concepts of Distributed systems	02	—
I	Introduction to DLT and Blockchain	Introduction to Blockchain: Technical definition of Blockchain. Elements of a blockchain Features of Blockchain Type of Blockchain, What is DLT . DLT V/S Blockchain CAP theorem Byzantine Generals Problem Consensus Mechanism and its Type Cryptographic primitives and data structure used in blockchain Block in a Blockchain: Structure of a Block, Block Header Hash and Block Height, The Genesis Block, Linking Blocks in the Blockchain, Merkle Tree. Self-learning Topics: Blockchain Demo	04	CO1
II	Bitcoin	What is Bitcoin and the history of Bitcoin, Bitcoin Transactions, Bitcoin Concepts: keys, addresses and wallets, Bitcoin Transactions, UTXO. validation of transactions, Bitcoin Keys , Addresses, ECC , Base58 , BIP-38 , Pay-to Script and Multisig Addresses, Vanity Addresses , Concept of Wallet, Wallet Technologies in Bitcoin HD wallet from Seed. Transaction Scripts and Scripts address, Bitcoin Mining and Difficulty levels Structure of Blocks and Blockheader and Genesis Block , linking of Block. Bitcoin Network: Bitcoin Core node and API, Peer-to- Peer Network Architecture, Node Types and Roles, Incentive based Engineering, The Extended Bitcoin Network, Bitcoin Relay Networks, Network Discovery, Full Nodes,	08	CO2



R-2025- B.E INFORMATION TECHNOLOGY

		Exchanging “Inventory”, Simplified Payment Verification (SPV) Nodes, SPV Nodes and Privacy, Transaction Pools, Blockchain Forks Bitcoin Testnet Basics of Bitcoin Forensics: Analysis of Address and Wallet , Clustering of Addresses following Money Self-learning Topics: Study and compare different consensus algorithms like PoA, PoS, pBFT		
III	Permissionless Blockchain: Ethereum	Introduction to Ethereum, Ethereum 1.0 and 2.0 , Turing completeness EVM and compare with bitcoin Basics of Ether Units, Ethereum Wallets Working with Metamask EOA and Contracts Transaction:: Structure of Transaction, Transaction Nonce, Transaction GAS, Recipient, Values and Data, Transmitting Values to EOA and Contracts Smart Contracts and Solidity Development environment and client , Basic of Solidity and Web 3 Life cycle of Smart contract, Smart Contract programming using solidity, Metamask (Ethereum Wallet), Setting up development environment, Use cases of Smart Contract, Smart Contracts: Opportunities and Risk. Smart Contract Deployment: Introduction to Truffle, Use of Remix and test networks for deployment Self-learning Topics: Smart contract development using Java or Python	10	CO3
IV	Permissioned Blockchain: Hyperledger Fabric	Introduction to Framework, Tools and Architecture of Hyperledger Fabric <u>Blockchain</u> . Components: Certificate Authority, Nodes, Chain codes, Channels, Consensus: Solo, Kafka, RAFT Designing Hyperledger Blockchain Other Challenges : Interoperability and Scalability of blockchain Self-learning Topics: Fundamentals of	07	CO4



R-2025- B.E INFORMATION TECHNOLOGY

		Hyperledger Composer		
V	Crypto assets and Cryptocurrencies	ERC20 and ERC721 Tokens, comparison between ERC20 & ERC721, NFT, ICO, STO, Different Crypto currencies Self-learning Topics: Defi, Metaverse, Types of cryptocurrencies	04	CO5
VI	Blockchain Applications & case studies	Blockchain in IoT, AI, Cyber Security Self-learning Topics: Applications of Blockchain in various domains Education, Energy, Healthcare, real- estate, logistics, supply chain	04	CO6

Text Books:

1. “Mastering Bitcoin, PROGRAMMING THE OPEN BLOCKCHAIN”, 2nd Edition by Andreas M. Antonopoulos, June 2017, Publisher(s): O'Reilly Media, Inc. ISBN: 9781491954386.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'Reilly.
3. Blockchain Technology, Chandramouli Subramanian, Asha A George, Abhillash K. A and Meena Karthikeyen, Universities press.
4. Hyperledger Fabric In-Depth: Learn, Build and Deploy Blockchain Applications Using Hyperledger Fabric, Ashwani Kumar, BPB publications
5. Solidity Programming Essentials: A beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication
6. Cryptoassets: The Innovative Investor's Guide to Bitcoin and Beyond, Chris Burniske & Jack Tatar.

Reference Books:

1. Mastering Blockchain, Imran Bashir, Packt Publishing
2. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media
3. Blockchain Technology: Concepts and Applications, Kumar Saurabh and Ashutosh Saxena, Wiley.
3. The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them, Antony Lewis. for Ethereum and Blockchain, Ritesh Modi, Packt publication.
4. Mastering Bitcoin Unlocking Digital Cryptocurrencies, Andreas M. Antonopoulos, O'Reilly Media



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL805	Blockchain Lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ITL805	Blockchain Lab	--	--	--	--	25	25	50

Lab Objectives:

Sr.No	Lab Objectives
1	To develop and deploy smart contracts on local Blockchain.
2	To deploy the smart contract on test networks.
3	To deploy and publish smart contracts on Ethereum test network.
4	To design and develop crypto currency.
5	To deploy chain code on permissioned Blockchain.
6	To design and develop a Full-fledged DApp using Ethereum/Hyperledger.

Lab Outcomes:

Sr.No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Develop and test smart contract on local Blockchain.	L3,L4
2	Develop and test smart contract on Ethereum test networks.	L3,L4
3	Write and deploy smart contract using Remix IDE and Metamask.	L4
4	Design and develop Cryptocurrency.	L4
5	Write and deploy chain code in Hyperledger Fabric.	L4
6	Develop and test a Full-fledged DApp using Ethereum/Hyperledger.	L5

Prerequisite: Programming Languages.

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 /45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	Java, Python, JavaScript	02	
I	Local Blockchain	Introduction to Truffle, establishing local Blockchain using Truffle Mini Project: Allocation of the groups	02	LO1
II	Smart contracts and Chain code	Solidity programming language, chain code (Java/JavaScript/Go), deployment on Truffle local Blockchain Mini Project: Topic selection	04	LO2
III	Deployment and publishing smart contracts on Ethereum test network	Ethereum Test networks (Ropsten/Gorelli/Rinkeby), deployment on test networks, Web3.js/Web3.py for interaction with Ethereum smart contract Mini Project: Topic validation and finalizing software requirements	04	LO3
IV	Remix IDE and Metamask	Smart contract development and deployment using Metamask and Remix Design and develop Crypto currency Mini Project: Study the required programming language for smart contract	04	LO4
V	Chain code deployment in Hyperledger Fabric	Chain code deployment in Hyperledger fabric Mini project: Study required front end tools	04	LO5
VI	Mini-project on Design and Development of a DApps using Ethereum/Hyperledger Fabric	Implementation of Mini Project 1. Design, configure and testing of mini project 2. Report submission as per guidelines	06	LO6



Mini project:

1. Students should carry out mini-project in a group of three/four students with a subject In-charge
2. The group should meet with the concerned faculty during laboratory hours and the progress of work discussed must be documented.
3. Each group should perform a detailed literature survey and formulate a problem statement.
4. Each group will identify the hardware and software requirement for their defined mini project problem statement.
5. Design, develop and test their smart contract/chain code.
6. Each group may present their work in various project competitions and paper presentations

Documentation of the Mini Project

The Mini Project Report can be made on following lines:

1. Abstract
2. Contents
3. List of figures and tables
4. Chapter-1 (Introduction, Literature survey, Problem definition, Objectives, Proposed Solution, Technology/platform used)
5. Chapter-2 (System design/Block diagram, Flow chart, Software requirements, cost estimation)
6. Chapter-3 (Implementation snapshots/figures with explanation, code, future directions)
7. Chapter-4 (Conclusion)
8. References

Text Books:

1. Ethereum Smart Contract Development, Mayukh Mukhopadhyay, Packt publication.
2. Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain, Ritesh Modi, Packt publication.
Hands-on Smart Contract Development with Hyperledger Fabric V2, Matt Zand, Xun Wu and Mark Anthony Morris, O'Reilly.

References Books:

1. Mastering Blockchain, Imran Bashir, Packt Publishing
2. Introducing Ethereum and Solidity, Chris Dannen, APress.
3. Hands-on Blockchain with Hyperledger, Nitin Gaur, Packt Publishing.



Online References:

1. <https://trufflesuite.com/>
2. <https://metamask.io/>
3. <https://remix.ethereum.org/>
4. <https://www.hyperledger.org/use/fabric>

Term-Work: Term-Work shall consist of 5 experiments and Mini-Project on above guidelines/syllabus. Also, Term-work must include at least 2 assignments and Mini-Project report.

Term Work Marks: 25 Marks (Total marks) =15 Marks (5 Experiments + Mini Project) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the Mini Project and Presentation.



		Teaching Scheme (Contact Hours)			Credits Assigned			
Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical & Oral	Tutorial	Total
ITL806	Cloud Computing lab	--	2	--	--	1	--	01

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ITL806	Cloud Computing lab	--	--	--	--	25	25	50

Lab Objectives:

Sr.No	Lab Objectives
1	To make students familiar with key concepts of virtualization.
2	To make students familiar with various deployment models of cloud such as private, public, hybrid and community.
3	To understand the using and adopting appropriate type of cloud for their application.
4	To make students familiar with various service models such as IaaS, SaaS, PaaS, Security as a Service (SECaaS) and Database as a Service.
5	Apply the different service models for the application.
6	To make students familiar with security and privacy issues in cloud computing and how to address them.

Lab Outcomes:

Sr.No	Lab Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
1	Implement different types of virtualization techniques.	L1, L3, L4
2	Analyze various cloud computing service models and implement them to solve the given problems.	L1, L2, L3, L4
3	Design and develop real world web applications and deploy them on commercial cloud(s).	L6
4	Explain major security issues in the cloud and mechanisms to address them.	L1, L2, L3
5	Explore various commercially available cloud services and recommend the appropriate one for the given application.	L1, L2, L3
6	Implement the concept of containerization.	L1, L2, L3



Prerequisite: Programming Languages, DBMS.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	Prerequisite	DBMS, Programming Language.	02	
I	Overview & Virtualization.	Introduction and overview of cloud computing. Hosted Virtualization using KVM. Lab1: To study and implement Hosted Virtualization using Virtual Box & KVM. Lab2: To study and Implement Bare-metal Virtualization using Xen, HyperV or VMware Esxi.	04	LO1
II	Infrastructure Services.	To study the infrastructure services using different cloud platform Lab3: To study and Implement Infrastructure as a Service using AWS/Microsoft Azure/Google cloud platform	04	LO2
III	Platform Services	To study the different platform services. Lab4: To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service.	03	LO3
IV	Cloud Services	IaaS, PaaS, STaaS, DbaaS, IAM and Security as a Service on AWS and Azure. Lab5: To study and Implement Security as a Service on AWS/Azure. Lab6: To study and implement Identity and Access Management (IAM) practices on AWS/Azure cloud.	04	LO4
V	Storage Services	To study the storage services using Docker. Lab7: To study and Implement Storage as a Service using Own Cloud/ AWS S3, Glaciers/ Azure Storage. Lab8: To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/MongoDB Lab/ Firebase. Lab9: To study and Implement Containerization using Docker on	04	LO5



R-2025- B.E INFORMATION TECHNOLOGY

		AWS/Azure/Google cloud platform.		
VI	Kubernetes	Introduction and overview of Kubernetes. Lab10: To study and implement container orchestration using Kubernetes on AWS/Azure/Google cloud platform	05	LO6

Textbooks:

1	Bernard Golden, “Amazon Web Services for Dummies”, John Wiley & Sons, Inc.
2	Michael Collier, Robin Shahan, “Fundamentals of Azure, Microsoft Azure Essentials”, Microsoft Press.
3	RajkumarBuyya, Christian Vecchiola, S ThamaraiSelvi, “Mastering Cloud Computing”, Tata McGraw-Hill Education.
4	Barrie Sosinsky, “Cloud Computing Bible”, Wiley publishing.
5	John Paul Mueller, “AWS for Admins for Developers”, John Wiley & Sons, Inc.
6	Ken Cochrane, Jeeva S. Chelladhurai, NeependraKhare , “Docker Cookbook - Second Edition”, Packt publication
7	Jonathan Baier, “Getting Started with Kubernetes-Second Edition”, Packt Publication.

Online References:

1. <https://phoenixnap.com/kb/ubuntu-install-kvm/>
2. NIST Cloud Computing Security Reference Architecture
3. <https://docs.citrix.com/en-us/xenserver/7-1/install.html>
4. <https://docs.aws.amazon.com>
5. <https://docs.microsoft.com/en-us/azure>
6. <https://docs.docker.com/get-started/>
7. <https://kubernetes.io/docs/home/>

Term-Work: Term-Work shall consist of 10 experiments on above guidelines/syllabus. Also, Term-work must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) =15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Attendance)

Oral Exam: An Oral exam will be held based on the syllabus.



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		(Contact Hours)						
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ITL807	Major Project – II	--	6	--	--	03	--	03

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract. /Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ITL807	Major Project – II	--	--	--	--	100	50	150

Course Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcome: Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Major Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of major project-I and major project-II.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.



R-2025- B.E INFORMATION TECHNOLOGY

- Faculty supervisor may give inputs to students during major project -I & II activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Major Project, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Major Project-I in semester VII and Major Project-II in semesters VIII.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Major Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to Scopus paper publications in Journal/Conference or Copyright or Patent as an extension of the Major Project-1 with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Major Project:

Term Work

1. The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in each semester VII and VIII.
2. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
3. Distribution of Term work marks for both semesters shall be as below;
 - a. Marks awarded by guide/supervisor based on log book : 10
 - b. Marks awarded by review committee 10
 - c. Quality of Project report 05

Review/progress monitoring committee may consider following points for assessment based on either one year major project as mentioned in general guidelines.

One-year project:

- In semester VII entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalization of problem and proposed solution of the problem
 - Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VIII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
 - First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.
 - Second review shall be based on paper presentation in conference/journal or motivate for copyright or Indian patent in last month of the said semester.



Assessment criteria of Major Project.

Major Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.

Guidelines for Assessment of Major Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Major Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Major Project shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication
9. Publications in Sem VIII.



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC821	Big Data Analytics	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC821	Big Data Analytics	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	To provide an overview of an exciting growing field of Big Data analytics.
2	To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3	To introduce the tools required to manage and analyze big data like Hadoop, NoSql MapReduce.
4	To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.
5	To introduce to the students several types of big data like social media, web graphs and data streams.
6	To enable students to have skills that will help them to solve complex real-world problems in decision support.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the motivation for big data systems and identify the main sources of Big Data in the real world.	L1,L2,L3
2	Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store, retrieve and process Big Data for Analytics.	L1,L2,L3
3	Implement several Data Intensive tasks using the Map Reduce Paradigm.	L1,L2,L3
4	Apply several newer algorithms for Clustering Classifying and finding associations in Big Data.	L1,L2,L3
5	Design algorithms to analyze Big data like streams, Web Graphs and Social Media data.	L6
6	Design and implement successful Recommendation engines for enterprises.	L6

Prerequisite: AI and DS



DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Data Mining, Data Science	02	
I	Introduction to Big Data	Introduction to Big Data, Big Data characteristics, types of Big Data, Traditional vs. Big Data business approach, Big Data Challenges, Examples of Big Data in Real Life, Big Data Applications Self-learning Topics: Identification of Big Data applications and its solutions	03	CO1
II	Introduction to Big Data Frameworks	What is Hadoop? Core Hadoop Components; Hadoop Ecosystem; Working with Apache Spark What is NoSQL? NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, MongoDB Self-learning Topics: HDFS vs GFS, MongoDB vs other NoSQL system, Implementation of Apache Spark	06	CO2
III	MapReduce Paradigm	MapReduce: The Map Tasks, Grouping by Key, The Reduce Tasks, Combiners, Details of MapReduce Execution, Coping With Node Failures. Algorithms Using MapReduce: Matrix- Vector Multiplication by MapReduce, Relational-Algebra Operations, Computing Selections by MapReduce, Computing Projections by MapReduce, Union, Intersection, and Difference by MapReduce, Computing Natural Join by MapReduce, Grouping and Aggregation by MapReduce, Matrix Multiplication, Matrix Multiplication with One MapReduce Step. Illustrating use of MapReduce with use of real life databases and applications. Self-learning Topics: Implementation of MapReduce algorithms like Word count, Matrix-Vector and Matrix-Matrix algorithm	07	CO3



R-2025- B.E INFORMATION TECHNOLOGY

IV	Mining Big Data Streams	The Stream Data Model: A DataStream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data in a Stream : Sampling Techniques. Filtering Streams: The Bloom Filter Counting Distinct Elements in a Stream : The Count-Distinct Problem, The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements . Counting Ones in a Window: The Cost of Exact Counts, The Datar-Gionis-Indyk, Motwani Algorithm, Query Answering in the DGIM Algorithm. Self-learning Topics: Streaming services like Apache Kafka/Amazon Kinesis/Google Cloud DataFlow. Standard spark streaming library. Integration with IOT devices to capture real time stream data.	07	CO4
V	Big Data Mining Algorithms	Frequent Pattern Mining : Handling Larger Datasets in Main Memory Basic Algorithm of Park, Chen, and Yu. The SON Algorithm and MapReduce. Clustering Algorithms: CURE Algorithm. Canopy Clustering, Clustering with MapReduce Classification Algorithms: Overview SVM classifiers, Parallel SVM, KNearest Neighbor classifications for Big Data, One Nearest Neighbour. Self-learning Topics: Standard libraries included with spark like graphX, MLlib	07	CO5
VI	Big Data Analytics Applications	Link Analysis : PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: PageRank Iteration Using MapReduce, Topic sensitive Page Rank, link Spam, Hubs and Authorities, HITS Algorithm. Mining Social- Network Graphs : Social Networks as Graphs, Types , Clustering of Social Network Graphs, Direct Discovery of Communities, Counting triangles using Map- Reduce. Recommendation Engines: A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering Self-learning Topics: Sample applications like social media feeds, multiplayer game interactions, retail industry, financial data analysis. Use case like location data, real-time stock trades, log monitoring etc	07	CO6



Text Books:

1. Anand Rajaraman and Jeff Ullman “Mining of Massive Datasets”, Cambridge University Press.
2. Alex Holmes “Hadoop in Practice”, Manning Press, Dreamtech Press.
3. Professional NoSQL Paperback, by Shashank Tiwari, Dreamtech Press
4. Rajkumar Buyya, ,Rodrigo N. Calheiros and Amir Vahid Dastjerdi, “Big Data Principles and Paradigms”, Morgan Kaufmann

References Books:

1. Analytics in a Big Data World: The Essential Guide to Data Science and its Applications, Bart Baesens , WILEY Big Data Series.
2. Big Data Analytics with R and Hadoop by Vignesh Prajapati Paperback, Packt Publishing Limited
3. Hadoop: The Definitive Guide by Tom White, O'Reilly Publications

Online References:

1. <https://nptel.ac.in/courses/106/104/106104189/>
2. <https://nptel.ac.in/courses/106/106/106106142/>
3. <https://nptel.ac.in/courses/106/105/106105186/>



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1958 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC822	Reinforcement Learning	03	--	--	03	--	--	03

Cou rse Co de	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practica l	Oral	Total
		Internal assessment			End Sem. Exa m				
		IAT 1	IAT 2	Total					
ITC822	Reinforcement Learning	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	Define the key features of reinforcement learning that distinguishes it from AI and non-interactive machine learning.
2	Introduce to statistical learning techniques where an agent explicitly takes actions and interacts with the world.
3	Implement in code common RL algorithms.
4	Describe multiple criteria for analyzing RL algorithms & evaluate algorithms on these metrics: e.g. regret, sample complexity, computational complexity, empirical performance, convergence, etc.
5	Know how to implement dynamic programming as an efficient solution approach to an industrial control problem.
6	Explore solutions to the Exploration-Exploitation Dilemma.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Learn how to define RL tasks and the core principles behind the RL, including policies, value functions, deriving Bellman equations.	L1,L2
2	Evaluate work with tabular methods to solve classical control problems.	L1,L2,L3
3	Apply Markov Decision Processes to solve real-world problems.	L1,L2,L3
4	Understand the dynamic programming for policy Evaluation.	L1,L2
5	Implement reinforcement learning problems based on averaging sample returns using Monte Carlo method.	L1,L2,L3
6	Recognize current advanced techniques and applications in RL.	L1,L2,L3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Probability distributions and expected values, and basic linear algebra (e.g., inner products).	02	
I	Introduction to Reinforcement Learning:	Reinforcement Learning: Key features and Elements of RL, Types of RL, rewards. Reinforcement Learning Algorithms: Q-Learning, State Action Reward State Action (SARSA), Self-learning Topics: Deep Q Neural Network (DQN), Applications of RL	04	CO1
II	Bandit problems And online learning:	An n-Armed Bandit Problem, Action-Value Methods Tracking a Nonstationary Problem, Optimistic Initial Values Upper-Confidence-Bound Action Selection Gradient Bandits Self-learning Topics: Associative Search (Contextual Bandits)	07	CO2
III	Markov Decision Processes:	The Agent–Environment Interface, Goals and Rewards, Returns, Markov properties, Markov Decision Process, Value Functions and Optimal Value Functions, Self-learning Topics: Optimality and Approximation	07	CO3
IV	Dynamic Programming:	Policy Evaluation (Prediction), Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming, Generalized Policy Iteration Self-learning Topics:	07	CO4
V	Monte Carlo Methods and Temporal-Difference Learning	Monte Carlo Prediction, Monte Carlo Estimation of Action Values, Monte Carlo Control, TD Prediction, TD control using Q-Learning Self-learning Topics: Off-policy Prediction via Importance Sampling	07	CO5
VI	Applications and Case Studies	Elevator Dispatching, Dynamic Channel Allocation, Job-Shop Scheduling Self-learning Topics: Study of applications.	05	CO6

Text Books:

1. Reinforcement Learning: An Introduction, by Richard S. Sutton and Andrew G. Barto
2. Alessandro Palmas, Dr. Alexandra Galina Petre, Emanuele Ghelfi, The Reinforcement Learning Workshop: Learn how to Apply Cutting-edge Reinforcement Learning Algorithms to a Wide Range of Control



R-2025- B.E INFORMATION TECHNOLOGY

Problems, 2020 Packt publishing.

3. Phil Winder, Reinforcement Learning Industrial Applications with Intelligent Agents, O'Reilly
4. Dr Engr S M Farrukh Akhtar, Practical Reinforcement Learning, Packt Publishing, 2017.

References Books:

1. Maxim Lapan, Deep Reinforcement Learning Hands-On: Apply modern RL methods, with deep Q-networks, value iteration, policy gradients, TRPO, AlphaGo Zero.
2. Csaba Szepesvári, Algorithms for Reinforcement Learning, Morgan & Claypool Publishers
3. Alberto Leon-Garcia, Probability, Statistics and Random Processes for Electrical Engineering, Third Edition, Pearson Education, Inc.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1958 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral		Total
ITC823	Simulation and Modeling	03	--	--	03	--		03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC823	Simulation and Modeling	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	To introduce the discrete event simulation systems.
2	To discuss the modeling techniques of entities, queues, resources and entity transfers in the discrete event environment.
3	To formulate and apply the statistical models in simulation and queuing theory.
4	To gain knowledge of random numbers, random variates and various statistical tests on random numbers.
5	To formulate and build valid models and perform simulation analysis of the system and analyze results properly.
6	To familiarize with various applications of Simulation.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the meaning of simulation and Identify the common applications of discrete-event system simulation.	L1,L2
2	Practice formulation and modeling skills.	L1,L2,L3
3	Analyze events and inter-arrival time, arrival process, queuing strategies, resources and disposal of entities using statistical models.	L1,L2,L3,L4
4	Understand pseudo-random numbers and perform statistical tests to measure the	L1,L2

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



R-2025- B.E INFORMATION TECHNOLOGY

	quality of pseudo-random numbers.	
5	Apply different distributions to fit the collected data and describe the process of verification and validation of simulation models.	L1,L2,L3
6	Describe various applications of simulation.	L1,L2

Prerequisite: Probability and Statistics

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Concepts of Probability: Probability mass function, Probability density function, Mean, Variance, Median, Mode	02	-
I	Introduction to Simulation	Simulation Definition, When Simulation is an appropriate tool and when it is not, Advantages and disadvantages of simulation, Areas of application of simulation, System and its types, Models and its types, Steps in simulation study Self-learning Topics: Monte Carlo simulation	04	CO1
II	Simulation Examples and General Principles	Simulation Process, Simulation of Single-server and multi-server queueing systems, Simulation of (M, N) Inventory and Newspaper Seller Problem, Simulation of Lead-time Demand Concepts in Discrete Event Simulation, Event Scheduling Algorithm, Manual Simulation of Single Server and Dump Truck Problem using Event Scheduling Algorithm Self-learning Topics: Simulation of Reliability Problem, Process Interaction Approach in Simulation.	08	CO2
III	Mathematical, Statistical and Queueing Models in Simulation	Statistical Models: Terminology and concepts, Useful statistical models, Discrete Distributions (Bernoulli's trial, Binomial and Negative Binomial, Poisson Distributions), Continuous Distributions (Exponential, Uniform, Erlang, Triangular and Normal Distributions), Poisson Process, Queueing Models: Queueing Notations, Long Run Performance Measures, M/M/1 and M/G/1 Queueing Systems Self-learning Topics:	08	CO3



R-2025- B.E INFORMATION TECHNOLOGY

IV	Random Numbers and Variates	Random Number Generation: Why are random numbers required in simulation? Properties of random numbers, Linear Congruential Method to generate Random Numbers, Test for Uniformity: Kolmogorov-Smirnov, Chi-Square, Test for Independence: Runs up and runs down, Runs above and below mean, Poker test), Random Variate Generation: Inverse Transform Technique, Direct Transformation for Normal and Lognormal distribution, Acceptance Rejection Technique Self-learning Topics: Tests for Autocorrelation	08	CO4
V	Analysis of Simulation Data	Steps in Input Modeling, Goodness-of-fit tests, Selecting Input Model without data, Multivariate and Time Series Models, Model Building verification and validation, Verification of simulation models, Naylor and Finger Approach for calibration and Validation of simulation models Self-learning Topics: Input-Output Validation: Using Historical Input Data	06	CO5
VI	Applications of Simulation	High-Level Computer-System Simulation and Memory Simulation, Simulation of Manufacturing and Material Handling Systems Self-learning Topics: Simulation of Computer Networks	03	CO6

Text Books:

1. J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2001), Discrete Event System Simulation, 3rd Ed., Prentice-Hall.
2. J. Banks, J. S. Carson, B. L. Nelson and D. M. Nicol (2001), Discrete Event System Simulation, 4th Ed., Prentice-Hall.

References Books:

1. A. M. Law and W. D. Kelton (2000), Simulation Modeling and Analysis, 4th Ed., McGraw Hill.
2. K. S. Trivedi (2001), Probability and Statistics with Reliability, Queuing and Computer Science Applications, Eastern Economy Edition, Prentice-Hall (India).
3. Banks C M, Sokolowski J A, Principles of Modeling and Simulation, Wiley
4. Geoffrey Gordon, System Simulation, EEE
5. Narsing Deo, System Simulation with Digital Computer; PHI



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Online References:

1. <https://www.udemy.com/course/discrete-event-system-simulation/>
2. https://www.tutorialspoint.com/modelling_and_simulation/index.htm



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

Shree Rahul Education Society's (Regd.)
An Autonomous Institute Affiliated to University of Mumbai,
Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1958 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC824	Knowledge Management	03	--	--	03	--	--	03

Subject Code	Subject Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC824	Knowledge Management	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	Establish a foundation of key terms and concepts, historical events and contributions, organizational benefits, and guiding principles on which to build greater understanding of knowledge management.
2	Appreciate the role and use of knowledge for individuals, as well as organizations and institutions.
3	Increase information and understanding about knowledge transfer using low- and high technology strategies.
4	Explore the future of knowledge management and its influence on our jobs, communities, and society.
5	Explore different tools for knowledge codification and knowledge transfer.
6	Discuss impact of knowledge management on product, people and organization, etc. with qualitative and quantitative measures.

Course Outcomes:

Sr. No.	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Discuss KM, learning organizations, intellectual capital and related terminologies in clear terms and understand the role of knowledge management in organizations.	L1,L2,L3
2	Demonstrate an understanding of the history, concepts, and the antecedents of management of knowledge and describe several successful knowledge management systems.	L1,L2,L3

Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

022-2812 0144 / 45 / 43 slrtce@rahuleducation.com www.rahuleducation.com



R-2025- B.E INFORMATION TECHNOLOGY

3	Evaluate the impact of technology including telecommunications, networks, and Internet/intranet role in managing knowledge.	L4,L5
4	Discuss new jobs, roles and responsibilities resulting from the New or Knowledge Economy Ponder KM's current and future impact on individuals, organizations and society at large.	L1,L2,L3
5	Apply different tools for knowledge transfer and Business Intelligence in knowledge sharing.	L1,L2,L3
6	Analyze different modes of knowledge conversion and testing tools for knowledge codification.	L1,L2,L3,L4

Prerequisite: An introductory course in IT/ IS

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Meaning of data, information, knowledge and expertise Meaning of epistemology, Types of Knowledge -Subjective & Objective views of knowledge, procedural Vs. declarative, tacit Vs. explicit, general Vs. specific.	02	
I	Introduction to Knowledge Management	What is Knowledge? Data, information and knowledge, Knowledge management process, Types of expertise – associational, motor skill, theoretical Characteristics of knowledge – explicitness, codifiability, teachability, specificity, Reservoirs of knowledge, Meaning of Knowledge Management, Forces Driving Organizational issues in KM, KM Systems & their role, Relevance of KM in today's dynamic & complex environment, Future of Knowledge Management Self-Learning Topics: Study the various KM process.	07	CO1
II	Knowledge management system life cycle	Challenges in Building KM Systems – Conventional versus KM System Life Cycle (KMSLS) – Knowledge Creation and Knowledge Architecture – Nonaka's Model of Knowledge Creation and Transformation, Knowledge Architecture. Self-Learning Topics: Case study for KMSLS.	06	CO2



R-2025- B.E INFORMATION TECHNOLOGY

III	KM Solutions for capture, sharing & applications	KM Processes, KM Systems, Mechanisms & Technologies, Knowledge Capturing Techniques: Brain Storming – Protocol Analysis – Consensus Decision Making – Repertory Grid- Concept Mapping –Blackboarding, Nominal Group Technique, Delphi method. Self-Learning Topics: Study various technologies used in KM in industry.	06	CO5
IV	Knowledge codification	Modes of Knowledge Conversion – Codification Tools and Procedures – Knowledge Developer's Skill Sets – System Testing and Deployment – Knowledge Testing –Approaches to Logical Testing, User Acceptance Testing – KM System Deployment Issues – User Training – Post implementation. Self-Learning Topics: Study different tools for testing for KM.	06	CO6
V	Knowledge transfer and sharing	Transfer Methods – Role of the Internet – Knowledge Transfer in e-world – KM System Tools – Neural Network – Association Rules – Classification Trees – Data Mining and Business Intelligence – Decision Making Architecture – Data Management – Knowledge Management Protocols – Managing Knowledge Workers. Self-Learning Topics: Case study for transfer methods in KM.	06	CO3
VI	KM Impact	Dimensions of KM Impact – People, Processes, Products & Organizational Performance Factors influencing impact – universalistic & contingency views Assessment of KM Impact – Qualitative & quantitative measures, Identification of appropriate KM solutions, Competing with Business Analytics, Caveats for managing Knowledge and Business Intelligence, Corporate social Responsibility, Ethical Legal and Managerial Issues: PAPA, Security and controls. Self-Learning Topics: Case study on KM impact.	06	CO4

Text Books:

1. Irma Becerra-Fernandez, Avelino Gonzalez, Rajiv Sabherwal (2004). Knowledge Management Challenges, Solutions, and Technologies. Prentice Hall. ISBN: 0-13-109931-0.
2. Elias M. Awad, Hassan M. Ghaziri (2004). Knowledge Management. Prentice Hall. ISBN: 0-13- 034820-1
3. Donald Hislop, Knowledge Management in Organizations, Oxford 2nd Edition. Ian Watson (2002).
4. Shelda Debowski, Knowledge Management, Wiley India Edition
5. Keri E Pearlson, Carol S. Saunders, Strategic Management of Information System, Wiley India Edition



References Books:

1. Madanmohan Rao (2004). Knowledge Management Tools and Techniques: Practitioners and Experts Evaluate KM Solutions. Butterworth-Heinemann. ISBN: 0750678186.
2. Stuart Barnes (Ed.) (2002). Knowledge Management Systems Theory and Practice. Thomson Learning.
3. Kimiz Dalkir, Knowledge Management in Theory and Practice, Elsevier, Butterworth Hinemann.
4. Applying Knowledge Management: Techniques for Building Corporate Memories. Morgan Kaufmann. ISBN: 1558607609.

Online resources:

1. https://onlinecourses.nptel.ac.in/noc19_mg33/preview
2. <https://www.udemy.com/course/knowledge-management/>
3. <https://www.coursehero.com/file/70272191/km-pdf-imppdf/>
4. http://cs.unibo.it/~gaspari/www/teaching/slides_KM6.pdf



Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC831	User Interface Design	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC831	User Interface Design	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	To stress the importance of good interface design.
2	To understand the importance of human psychology as well as social and emotional aspect in designing good interfaces.
3	To learn the techniques of data gathering, establishing requirements, analysis and data interpretation.
4	To learn the techniques for prototyping and evaluating user experiences.
5	To understand interaction design process and evaluate design.
6	To bring out the creativity in each student – build innovative applications that are usable, effective and efficient for intended users.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Identify and criticize bad features of interface designs.	L1,L2,L3
2	Predict good features of interface designs.	L1,L2,L3
3	Illustrate and analyze user needs and formulate user design specifications.	L1,L2,L3
4	Interpret and evaluate the data collected during the process.	L1,L2,L3
5	Evaluate designs based on theoretical frameworks and methodological approaches.	L1,L2,L3,L4,L5
6	Apply better techniques to improve the user interaction design interfaces.	L1,L2,L3



Prerequisite: Software Engineering.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hour	CO Mapping
0	Prerequisite	Software Engineering concepts and any programming Language Self-learning Topics: Web design languages	02	NA
I	Introduction to Interaction Design	Good and Poor Design, What is Interaction Design, The User Experience, The Process Of Interaction Design, Interaction Design and the User Experience, Necessity of UI/UX Self-learning Topics: Study of Various interactive day to day application	05	CO1
II	Understanding and Conceptualizing Interaction Cognitive aspects and Social, Emotional Interaction	Understanding the Problem Space and Conceptualizing Design, Conceptual Model, Interface Types, Cognitive aspects, Social Interaction and the Emerging Social Phenomena, Emotions and the User Experience, Expressive and Frustrating Interfaces, Persuasive Technologies Self-learning Topics: Study of Various interactive Interface Types	05	CO2
III	Data Gathering, Establishing Requirements, Analysis, Interpretation and Presentation	Establishing Requirements, Five Key Issues, Techniques for Data Gathering, Data Analysis Interpretation and Presentation, Task Description and Task Analysis Self-learning Topics: Any case study of how to gather requirements .(eq.BE Project)	08	CO3
IV	Process of Interaction Design, Prototyping, Construction.	Interaction Design Process, Prototyping and Conceptual Design, Interface Metaphors and Analogies Self-learning Topics: Study of two websites with usability concepts.	07	CO4 / CO5



R-2025- B.E INFORMATION TECHNOLOGY

V	Design rules and Industry standards	Design principles, Principles to support Usability, Standards and Guidelines, Golden rules and Heuristics, ISO/IEC standards .The 15 Rules Every UI/UX Designer Should Know . Self-learning Topics: Study experiments on industry standards and design principles . principles. https://xd.adobe.com/ideas/career-tips/15-rules-every-ux-designer-know/	07	CO5
VI	Evaluation Techniques and Framework	The Why, What, Where and When of Evaluation, Types of Evaluation, case studies, DECIDE Framework, Usability Testing, conducting experiments, Field studies, Heuristic Evaluation and walkthroughs, Predictive models. Self-learning Topics: Evaluation of any GUI with usability principles.	05	CO5/ CO6

Text Books:

1. Interaction Design, by J. Preece, Y. Rogers and H. Sharp. ISBN 0-471-49278-7.
2. Human Computer Interaction, by Alan Dix, Janet Finlay, Gregory D Abowd, Russell Beale
3. Alan Cooper, Robert Reimann, David Cronin, “About Face3: Essentials of Interaction design”, Wiley publication.
4. Wilbert O. Galitz, “The Essential Guide to User Interface Design”, Wiley publication.

References Books:

1. The UX Book, by Rex Hartson and Pardha S Pyla
2. Donald A. Norman, “The design of everyday things”, Basic books.
3. Jeff Johnson, “Designing with the mind in mind”, Morgan Kaufmann Publication.
4. UI Design: Key to captivate User Understanding, by Nilakshi Jain, Dhananjay Kalbande

Online References:

1. https://onlinecourses.nptel.ac.in/noc21_ar05/preview
2. <https://nptel.ac.in/courses/124/107/124107008/>
3. <https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ar10/>
4. <https://nptel.ac.in/courses/107/103/107103083/>
5. <https://www.youtube.com/watch?v=6C2Ye1makdY&list=PLW-zSkCnZ-gD5TDfs1eL5EnH2mQ0f9g6B>
6. <https://xd.adobe.com/ideas/process/>



Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/ Oral	Tutorial	Total
ITC832	Robotics	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Ter m Wor k	Practical	Oral	Total
		Internal assessment			End Sem. Exa m				
		IAT 1	IAT 2	Total					
ITC832	Robotics	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
1	Learn the basic concepts of Robot.
2	Learn the concepts of Kinematics of Robotics.
3	Learn the different types of Actuators and Sensors in Robot Designing.
4	Learn the concepts of Motions, Velocities and Dynamic Analysis of Force.
5	Learn the concepts of Trajectory and Motion Planning.
6	Learn the different Programming Languages to program Robot.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand different types of robot, its characteristics and applications.	L1,L2
2	Analyse kinematics parameters of robotic manipulator.	L1,L2,L3,L4
3	Identify actuators, sensors and control of a robot for different applications.	L1,L2,L3
4	Apply the differential relationships of motion, velocities and dynamic analysis of force.	L1,L2,L3
5	Apply the concept of trajectory and motion planning in robot programming.	L1,L2,L3
6	Use robot programming languages and acquire skills to program robots.	L1,L2,L3

Prerequisite: Mathematical concepts of Geometry, Linear Algebra, Calculus, Basic Electronics



DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Homogenous Coordinate System, Matrix Representation and its Operations, Vector Algebra: Dot and Cross Products, Orthogonal and Orthonormal Vectors	02	--
I	Introduction and Fundamentals of Robotics	Automation and its types, definition of Robotics and a Robot, History of Robotics, Advantages and Disadvantages of Robot, Robotic Manipulators, Robot Motions, Robot Anatomy, Links and Joints, Classification of Robots, Specification of Robot, Applications of Robots Self-learning Topics: Robot Coordinate System, Economic and Social Aspects of Robotics	04	CO1
II	Direct and Inverse Kinematics	Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations for position and orientation, Denavit-Hartenberg Representation of Forward Kinematic Equations of Robots, The Inverse Kinematic Solution of Robots, Case Studies: Three Axes Planar Articulated Robot Arm (Mini-Drafter) and Four Axes Adept-1 SCARA robot Self-learning Topics: Study of Five Axes Rhino XR- Robot Arm and Six Axes Articulated Intelledex 660 Robot Arm	08	CO2
III	Actuators and Sensors	Characteristics of Actuating Systems, Comparison of Actuating Systems, Hydraulic Devices, Pneumatic Devices, Electric Motors, Magnetostrictive Actuators, Sensor Characteristics, Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Pressure Sensors, Torque Sensors, Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors, Sniff Sensors, Vision Systems, Voice Synthesizer Self-learning Topics: Microprocessor Control of Electric Motors, Microswitches, Range Finders, Voice Recognition Devices	06	CO3



R-2025- B.E INFORMATION TECHNOLOGY

IV	Motions, velocities and dynamic analysis of force	Differential relationship, Jacobian, Differential motions of a frame and robot, Inverse Jacobian, Lagrangian mechanics, Moments of Inertia, Dynamic equations of robots, Transformation of forces and moment between coordinate frames Self-learning Topics: Static Force Analysis of Robots	08	CO4
V	Trajectory and Motion Planning	Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories, Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug Self-learning Topics: Case Study based on real life application of motion planning (eg. Chess Game, Robotic Race, etc.)	05	CO5
VI	Introduction to Robot Programming	Definition of Robot Program, Robot Programming Techniques like Online programming, Lead-through programming, Walk-through programming, Offline programming, Task programming, Motion Programming, Robotic Programming Language: Overview, Requirements for Standard Robot Language, Introduction to Robot Languages like AL, AML, RAIL, RPL, VAL, etc. Self-learning Topics: Example of Robot Program using VAL	06	CO6

Text Books:

1. Robert Shilling, “Fundamentals of Robotics-Analysis and control”, PHI, 2003.
2. Saeed B. Niku, “Introduction to Robotics Analysis, Systems, Applications”, 3rd Edition, Wiley, 2019.
3. Saha, S.K., “Introduction to Robotics”, 2nd Edition, McGraw-Hill Higher Education, New Delhi, 2014.
4. Ashitava Ghoshal, “Robotics-Fundamental Concepts and Analysis”, Oxford University Press, Sixth impression, 2010
5. Mukherjee S., “Robotics Process Automation”, 1st Edition, Khanna Publishing House, New Delhi, 2020.

References Books:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, 3rd Edition, Pearson Education, India, 2009
2. Mark W. Spong & M. Vidyasagar, “Robot Dynamics & Control”, 2nd Wiley India Pvt. Ltd., 2004
3. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, 1st Edition, Shroff



R-2025- B.E INFORMATION TECHNOLOGY

Publishers, 2013

4. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion –Theory, Algorithms and Implementations”, Prentice-Hall of India, 2005
5. Fu, Gonzalez, Lee, “Robotics: Control, Sensing, Vision and Intelligence”, 1st Edition, Mc Graw Hill, India.

Online References:

1. https://swayam.gov.in/nc_details/NPTEL
2. <https://www.udemy.com/course/robotics-course/>
3. <https://www.coursera.org/courses?query=robotics>



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical/Oral	Tutorial	Total
ITC833	ERP	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Ter m Wor k	Practical	Oral	Total
		Internal assessment			End Sem. Exa m				
		IAT 1	IAT 2	Total					
ITC833	ERP	20	20	40	60	--	--	--	100

Course Objectives:

Sr. No.	Course Objectives
1	To learn the basic concepts of ERP.
2	To learn different technologies used in ERP.
3	To learn the concepts of ERP Manufacturing Perspective and ERP Modules.
4	To learn what are the benefits of ERP.
5	To study and understand the ERP life cycle.
6	To learn the different tools used in ERP.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Understand the basic concepts of ERP.	L1,L2
2	Identify different technologies used in ERP.	L1,L2,L3
3	Understand and apply the concepts of ERP Manufacturing Perspective and ERP Modules.	L1,L2
4	Discuss the benefits of ERP.	L1,L2,L3
5	Understand and implement the ERP life cycle.	L1,L2
6	Apply different tools used in ERP.	L1,L2,L3

Prerequisite: Basics of software



DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of software.	02	--
I	Introduction to ERP	Enterprise – An Overview Integrated Management Information, Business Modeling, Integrated Data Model Self-Learning Topics: Study of advantages of ERP.	04	CO1
II	ERP Technologies	Business Processing Reengineering(BPR), Data Warehousing, Data Mining, On-line Analytical Processing(OLAP), Supply Chain Management (SCM), Customer Relationship Management(CRM), MIS - Management Information System, DSS - Decision Support System, EIS - Executive Information System Self-Learning Topics: Study different ERP technologies.	06	CO2
III	ERP Manufacturing Perspective and ERP Modules	MRP - Material Requirement Planning, BOM - Bill Of Material, MRP - Manufacturing Resource Planning, DRP – Distributed Requirement Planning, PDM - Product Data Management. Finance, Plant Maintenance, Quality Management, Materials Management. Self-Learning Topics: Study different ERP modules.	08	CO3
IV	Benefits of ERP	Reduction of Lead-Time, On-time Shipment, Reduction in Cycle Time, Improved Resource Utilization, Better Customer Satisfaction, Improved Supplier Performance, Increased Flexibility, Reduced Quality, Costs, Improved Information Accuracy and Design-making Capability. Self-Learning Topics: Study of benefits of ERP for real time application.	08	CO4



R-2025- B.E INFORMATION TECHNOLOGY

V	ERP Life cycle	Pre-evaluation Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation Team Training, Testing, Going Live, End-user Training, Post- implementation (Maintenance mode). Self-Learning Topics: ERP testing tools.	05	CO5
VI	E-Commerce to E-business	E-Business structural transformation, Flexible Business Design, Customer Experience, Create the new techo enterprise, New generation e- business leaders, memo to CEO, Empower your customer, Integrate Sales and Service, Integrated Enterprise applications. Enterprise resource planning the E- business Backbone Enterprise architecture, planning, ERP usage in Real world, ERP Implementation. Self-Learning Topics: ERP Applications.	06	CO6

Text Books:

1. Enterprise Resource Planning - Alexis Leon, Tata McGraw Hill.
2. Enterprise Resource Planning – Diversified by Alexis Leon, TMH.
3. Enterprise Resource Planning - Ravi Shankar & S. Jaiswal , Galgotia.

References Books:

1. Guide to Planning ERP Application, Annetta Clewto and Dane Franklin, McGraw-Hill, 1997
2. The SAP R/3 Handbook, Jose Antonio, McGraw – Hill
3. E-Business Network Resource planning using SAP R/3 Baan and Peoplesoft : A Practical Roadmap For Success By Dr. Ravi Kalakota

Online References:

1. <https://www.udemy.com/>
2. <https://www.sap.com/>
3. www.oracle.com



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Theory	Practical	Tutorial	Theory	Practical /Oral	Tutorial	Total
ITC834	Cloud Computing and Services	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term Work	Practical	Oral	Total
		Internal assessment			End Sem. Exam				
		IAT 1	IAT 2	Total					
ITC834	Cloud Computing and Services	20	20	40	60	--	--	--	100

Course Objectives:

Sr.No	Course Objectives
1	Understand and analyze the basics of cloud computing, service models, deployment models and architecture.
2	Define and understand the concept of virtualization and related technologies.
3	Understand the different cloud computing services and their relevance's.
4	Describe the various services provided by Amazon Web Services cloud platform.
5	Understand and analyze the functionality of Openstack cloud platform & Serverless computing.
6	Describe the aspects of Security & Privacy in cloud computing.

Course Outcomes:

Sr. No	Course Outcomes	Cognitive levels of Attainment as per Bloom's Taxonomy
On successful completion, of course, learner/student will be able to:		
1	Explain the basic concepts of cloud computing like service models, deployment models and its architecture.	L1,L2,L3
2	Describe and apply virtualization in cloud computing.	L1,L2,L3
3	Use and Analyze different cloud computing services.	L1,L2,L3,L4
4	Understand and apply various services provided by Amazon Web Services cloud platform.	L1,L2,L3
5	Discuss the functionality of Openstack cloud platform & Serverless computing.	L1,L2,L3
6	Recognize and examine the security and privacy concerns in cloud computing.	L1,L2,L3



Prerequisite: Computer Network, Operating System.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Concepts of Computer Network, Network Security and Operating System.	02	
I	Introduction to cloud computing	Introduction to cloud computing, need for cloud computing and its components, cloud & other similar configurations, cloud types: NIST and Cloud Cube Model, characteristics of cloud computing, deployment models, service models, advantages and disadvantages of Cloud Computing. Self-learning Topics: Study the recent trends in cloud computing architectures and related technologies.	06	CO 1
II	Virtualization	Characteristics of virtualized environment, structures of virtualization, implementation levels of virtualization, mechanisms of virtualization, pros and cons of virtualization, virtualization vs cloud computing, Xen and KVM architecture. Self-learning Topics: Comparison between different virtualization platforms.	06	CO 2
III	Cloud Computing Services	SPI Model of Cloud computing, Everything as a Service (XaaS): Database as a Service, Storage as a Service, Security as a Service, Collaboration as a Service, Monitoring as a Service, Network as a Service, Disaster Recovery as a service, Identity management as a Service, Analytics as a Service and Backup as a Service. Self-learning Topics: Study of different cloud computing platforms providing XaaS services.	04	CO 3



R-2025- B.E INFORMATION TECHNOLOGY

IV	Amazon Service Platform	Web Cloud	Introduction to the AWS Cloud, AWS core services by categories. Compute Service: Introduction to EC2, EC2 Instances, EC2 Amazon Machine Images, Instance Types, Instance Lifecycle. Storage Service: Introducing S3, working with Buckets, setting bucket security, S3 event and notification, bucket properties, working with Elastic Block Store Volumes, Object Storage Vs Block Storage, Archives versus backups, Introduction to Glacier. Virtual Private Cloud: Introduction, Subnet, Elastic Network Interfaces, Internet Gateways, Route Tables, Security Groups. CloudWatch: Introduction, CloudWatch Metrics, CloudWatch Alarms. Database as a Service: Introduction to Amazon Relational Database Service (RDS), Database Engines, Database Instance Classes, Backup and Recovery, Non-relational (No-SQL) Databases, Types of Non relational Databases, Introduction to DynamoDB, Features, Partition and Hash Keys. Self-learning Topics: Comparison of AWS services with other cloud service platforms like Azure and GCP	09	CO 4
V	Openstack Cloud platform & Serverless Computing		Open source Cloud Platform: Introduction to Openstack cloud platform, Components and modes of Operations, Architecture of Openstack cloud platform. Mobile Cloud Computing: Definition, architecture, benefits and challenges of mobile cloud computing. Serverless Computing: Introduction, Working with Serverless environment, Basics of serverless events and functions, AWS Lambda. Self-learning Topics: To study different open source cloud computing platforms and compare them based on different XaaS services provided by them.	05	CO 5
VI	Cloud Security & Privacy		What is security, why is it required in cloud computing, Different types of security in cloud, attacks, and vulnerabilities, IaaS security, PaaS security, SaaS security, trust boundary, Audit and reporting. Introduction to Identity and access Management (IAM), IAM Challenges, IAM Definition, IAM	07	CO 6



R-2025- B.E INFORMATION TECHNOLOGY

		Architecture and Practice, Relevant IAM Standards and Protocols for Cloud Services. Privacy: What Is Privacy? What Are the Key Privacy Concerns in the Cloud?, Legal and Regulatory Implications: Laws and Regulations, Governance, Risk, and Compliance (GRC). Self-learning Topics: To assess and analyze how the security and privacy is maintained in different cloud computing platforms.		

Text Books:

1. Cloud computing Bible, Barrie Sosinsky, Wiley publication.
2. Cloud Computing Black Book, Kailash Jayaswal, Jagannath Kallalurchi, Donald J. Houde, Dr. Deven Shah, Dreamtech Press
3. Mastering Cloud Computing, Rajkumar Buyya, MGH publication
4. AWS certified solution Architect, Joe Baron et.al, Cybex publication
5. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, and Shahed Latif, O'Reilly Publication.
6. Cloud security: A comprehensive guide to secure cloud computing by ronold L Krutz and Russell Dean Vines, Wiley publication.

Reference Books:

1. Distributed and Cloud Computing From Parallel Processing to the Internet of Things, Kai Hwang, Geoffrey C. Fox, Jack Dongarra, Morgan Kaufmann Publication
2. Cloud Computing for Dummies, Judith Hurwitz, Wiley Publication
3. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'Reilly Publication.
4. Cloud computing security: foundation and challenges, John R Vecca, CRC Press

Online References:

1. <https://www.aws.amazon.com>
2. <https://www.nttel.ac.in>



Course Code	Course Name	Credits
OEC8401	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming & performing), team dynamics.	6



R-2025- B.E INFORMATION TECHNOLOGY

03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart, Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. Project Contracting Project procurement management, contracting and outsourcing,	8
06	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6

REFERENCES:

1. Jack Meredith & Samuel Mantel, Project Management: A managerial approach, Wiley India, 7thEd.
2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9 th Ed.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS402	Finance Management	03

Objectives:

- Overview of Indian financial system, instruments and market
- Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
- Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

- Understand Indian finance system and corporate finance
- Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06
02	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06



R-2025- B.E INFORMATION TECHNOLOGY

03	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities	10
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of Optimal Capital Structure	05
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

REFERENCES:

1. Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2. Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3. Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS403	Entrepreneurship Development and Management	03

Objectives:

- To acquaint with entrepreneurship and management of business
- Understand Indian environment for entrepreneurship
- Idea of EDP, MSME

Outcomes: Learner will be able to...

- Understand the concept of business plan and ownerships
- Interpret key regulations and legal aspects of entrepreneurship in India
- Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09
03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05



R-2025- B.E INFORMATION TECHNOLOGY

04	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSME Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

- Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
- Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, Entrepreneurship, latest edition, The McGrawHill Company
- Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
- Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
- Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House
- Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
- Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
- Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
- Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
- Laghu Udyog Samachar
- www.msme.gov.in
- www.dcmesme.gov.in
- www.msmetraining.gov.in



SHREE L. R. TIWARI COLLEGE OF ENGINEERING

An Autonomous Institute Affiliated to University of Mumbai,

Approved by AICTE & DTE, Maharashtra State | NAAC Accredited, NBA Accredited Program | ISO 9001:2015 Certified |
DTE Code No: 3423 | Recognized under Section 2(f) of the UOC Act 1956 | Minority Status (Hindi Linguistic)

R-2025- B.E INFORMATION TECHNOLOGY

📍 Shree L. R. Tiwari Educational Campus, Mira Road (East), Thane- 401 107, Maharashtra.

☎ 022-2812 0144 / 45 / 43 ✉ slrtce@rahuleducation.com 🌐 www.rahuleducation.com



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS404	Human Resource Management	03

Objectives:

9. To introduce the students with basic concepts, techniques and practices of the human resource management.
10. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
11. To familiarize the students about the latest developments, trends & different aspects of HRM.
12. To acquaint the student with the importance of inter-personal & inter-group behavioral skills in an organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5



R-2025- B.E INFORMATION TECHNOLOGY

02	Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness: High performing teams, Team Roles, cross functional and self-directed team. Case study	7
03	Organizational Structure & Design Structure, size, technology, Environment of organization; Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.	6
04	Human resource Planning Recruitment and Selection process, Job-enrichment, Empowerment - Job- Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
05	Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
06	HR & MIS Need, purpose, objective and role of information system in HR, Applications in HRD in various industries (e.g. manufacturing R&D, Public Transport, Hospitals, Hotels and service industries) Strategic HRM Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10



REFERENCES:

1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS405	Professional Ethics and Corporate Social Responsibility (CSR)	03

Objectives:

13. To understand professional ethics in business
14. To recognize corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05
05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08



R-2025- B.E INFORMATION TECHNOLOGY

06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. [Corporate Social Responsibility in India \(2015\) by Bidyut Chakrabarty, Routledge, New Delhi.](#)



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS406	Research Methodology	03

Objectives:

15. To understand Research and Research Process
16. To acquaint students with identifying problems for research and develop research strategies
17. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research Issues and Problems in Research Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research Basic Research Applied Research Descriptive Research Analytical Research Empirical Research Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07



R-2025- B.E INFORMATION TECHNOLOGY

04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: • Identification and Selection of Research Problem • Formulation of Research Problem • Review of Literature • Formulation of Hypothesis • Formulation of research Design • Sample Design • Data Collection • Data Analysis • Hypothesis testing and Interpretation of Data • Preparation of Research Report	08
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	04

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology-Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OEC8407	IPR and Patenting	03

Objectives:

18. To understand intellectual property rights protection system
19. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
20. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07
03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non-patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07



R-2025- B.E INFORMATION TECHNOLOGY

05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publication etc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	07

REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
5. Cornish, William Rodolph & Llewelyn, David. 2010, Intellectual Property: Patents, Copyrights, Trade Marks and Allied Right, 7th Edition, Sweet & Maxwell
6. Lous Harns, 2012, The enforcement of Intellectual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
11. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OEC8408	Digital Business Management	03

Objectives:

21. To familiarize with digital business concept
22. To acquaint with E-commerce
23. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E-government and learning to C2C, mobile commerce and pervasive computing EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e-commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	06



R-2025- B.E INFORMATION TECHNOLOGY

3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
4	Managing E-Business- Managing Knowledge, Management skills for e-business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy- E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	08

References:

1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014
4. Introduction to E-business-Management and Strategy, Colin Combe, ELSVIER, 2006
5. Digital Business Concepts and Strategy, Eloise Coupey, 2nd Edition, Pearson
6. Trend and Challenges in Digital Business Innovation, Vinocenzo Morabito, Springer
7. Digital Business Discourse Erika Darics, April 2015, Palgrave Macmillan
8. E-Governance-Challenges and Opportunities in : Proceedings in 2nd International Conference theory and practice of Electronic Governance
9. Perspectives the Digital Enterprise –A framework for Transformation, TCS consulting journal Vol.5
10. Measuring Digital Economy-A new perspective -DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en) OECD Publishing



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Credits
OECS409	Environmental Management	03

Objectives:

- 1 Understand and identify environmental issues relevant to India and global concerns
- 2 Learn concepts of ecology
- 3 Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man- made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency.Environment QualityManagement and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03



REFERENCES:

1. Environmental Management: Principles and Practice, C J Barrow, Routledge Publishers London, 1999
2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G.Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
7. Environment and Ecology, Majid Hussain, 3rd Ed. Access Publishing.2015



R-2025- B.E INFORMATION TECHNOLOGY

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OJT899	Internship/ Apprenticeship	-	8	-	-	-	-	4

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total of 2 Tests				
OJT899	Internship/ Apprenticeship	--	--	--	--	25	--	25

Course Objectives:

The course is designed so as to expose the students to industry environment and to take up on-site assignment as trainees or interns. But the volatile dynamics of industry requirements and its own way of scrutinizing students and providing them the opportunities prevent students from getting equal out-house internship opportunities. Consequently, weaker students get fewer opportunities while bright students get more. Therefore, to create equal opportunities among students, in-house internship is strengthened even though the college show strong preference for out-house internship.

Course Outcomes:

1. Demonstrate professional and ethical responsibility.
2. Understand the impact of engineering solutions in a global, economic, environmental and societal context.
3. Develop the ability to engage in research and to involve in life-long learning.
4. Comprehend contemporary issues

Internship Modes:

1. **Track A – Internship (External):** Traditional industry internship outside campus.
2. **Track B – Apprenticeship (In-house):** Skill development with industry mentor within the college, especially for domains like AI/ML, DevOps, Cybersecurity, etc.

Internship vs Apprenticeship

Aspect	Internship	Apprenticeship
Nature	Typically short-term, focused on exposure and learning	More structured, skill-based, focused on hands-on experience
Duration	4-8 weeks (can vary)	4-6 months
Certification	Ends with a formal certificate	Ends with a formal certificate
Supervision	Faculty or external	Usually industry mentor-drive
Alignment	Curriculum-aligned but flexible	Skill- and competency-based learning, aligned with NSQF/AICTE



A. Internship (Industry/Research Labs/Startups)

- Students are placed through T&P cell initiatives or self-arranged industry internships.
- Faculty or Industry mentor assigned for weekly monitoring.

Required Deliverables:

- Weekly interaction record (date, time, discussion summary)
- Weekly feedback form from industry mentor
- Final Internship Certificate from industry
- Internship Report

B. Apprenticeship (Department-Driven)

Apprenticeships are designed to ensure equitable access to industry-relevant learning for all students. These are not substitutes for value-added training but structured, outcome-driven engagements that simulate professional project environments.

Projects must align with:

- Smart India Hackathon problem statements (past/current)
- NITI Aayog challenges or national-level missions

Required Deliverables:

- Skill-oriented training with defined outcomes
- Defined problem statement
- Faculty and Industry mentor assigned for weekly monitoring
- Project work log (weekly)
- Final Project Report
- Mentor evaluation sheet