



Department of Computer Engineering

Curriculum FE to BE for A.Y 2025-26

First Year to Final Year Syllabus

Prepared by: Board of Studies for Computer Engineering

**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 Stakeholder,

It is an honour to present the revised Bachelor of Engineering (Computer Engineering) curriculum—our first under SLRTCE’s recently granted Autonomous status. The programme aligns with the National Education Policy 2020, which mandates a four-year multidisciplinary engineering framework, multiple entry-exit options and a semester credit band for all autonomous engineering colleges.

This curriculum is directed through a coherent academic pathway that includes the **Master of Engineering in Computer Engineering** and two work-oriented **B.Voc programmes Cyber Security & Digital Forensics** and **Big Data & Cloud Computing** ensuring learners can progress from foundational study to specialised expertise in high-growth domains.

Each semester of the B.E. programme is built around real-world problem statements mapped to the United Nations Sustainable Development Goals. Students tackle these challenges through our IDEA Lab pipeline, moving from design thinking to prototyping and product development. This approach balances rigorous theory with hands-on practice while nurturing ethical leadership, social responsibility and entrepreneurial spirit.

Laboratory session, open electives, value-added courses, audit courses, and internships cultivate broad competence, while independent-study components reinforce lifelong learning. Field projects and community-engagement activities now embedded as credit-bearing requirements strengthen our industry-academic linkages and societal impact, exactly as the state directives envisage.

We extend sincere thanks to Respected Mr Utsav Tiwari, Chief Operating Officer of Rahul Education, and to our Respected Principal, Dr Deven Shah, for their strategic guidance. I am equally grateful to our faculty colleagues, industry experts, alumni and student representatives whose insights shaped this curriculum.

Your constructive feedback will enable us to uphold SLRTCE’s vision of producing technically skilled, ethically grounded and socially conscious professionals equipped for the challenges of the twenty-first century.

Warm regards,

Dr Bhushankumar P. Nemade

Chairperson, Board of Studies, Computer Engineering
SLRTCE

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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

Curriculum Structure and Examination Scheme for B.E. in Computer Engineering
(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	
12111101	BSC	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
12121102	ESC	Engineering Mechanics	2	--	--	30	--	--	30	60	2
12121103	ESC	Digital logic and Computer Organization Architecture	3	--	--	45	--	--	45	90	3
12121104	ESC	Internet Technology	2	--	--	30	--	--	30	60	2
12121105	ESC	C and C++ Programming	3	--	--	45	--	--	45	90	3
12122106	ESCL	Engineering Mechanics Lab	--	--	1	--	--	15	--	15	0.5
12122107	ESCL	Digital logic and Computer Organization Architecture Lab	--	--	2	--	--	30	--	30	1
12122108	ESCL	Internet Technology lab	--	--	2	--	--	30	--	30	1
12122109	ESCL	C and C++ - Programming Lab	--	--	2	--	--	30	--	30	1
12122110	ESCL	IDEA LAB -1 (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

12412111	VSEC	Workshop -I	--	--	2	--	--	30	15	45	1.5
98461112	CC	Universal Human Values	2	--	--	30	--	--	30	60	2
98421113	AEC	Corporate Communication	1	–	-	15	--	–	15	30	1
98422114	AECL	Corporate Communication Lab	-	-	2	--	–	30	–	30	1
Total			16	1	13	240	15	195	270	720	24

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%. 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 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	IAT-1 + IAT-2		End - Sem			
12111101	BSC	Linear Algebra and Calculus	20	20	40	60	2.5	25	–	125
12121102	ESC	Engineering Mechanics	20	20	40	60	2.5	–	–	100
12121103	ESC	Digital logic and Computer Organization Architecture	20	20	40	60	2.5	–	–	100
12121104	ESC	Internet Technology	20	20	40	60	2.5	–	–	100
12121105	ESC	C and C++ Programming	20	20	40	60	2.5	–	–	100
12122106	ESCL	Engineering Mechanics Lab	–	–	–	–	–	25	–	25
12122107	ESCL	Digital logic and Computer Organization Architecture lab	–	–	–	–	–	25	25	50
12122108	ESCL	Internet Technology lab	–	–	–	–	–	25	25	50
12122109	ESCL	C and C++ Programming Lab	–	–	--	–	--	25	25	50
12122110	ESCL	IDEA LAB -1 (Innovation Design Engineering and Apply)	–	–	--	–	--	50	50	100
12412111	VSEC	Workshop -I	–	–	--	--	--	25	--	25

98461112	CC	Universal Human Values	–	–	–	–	–	25	--	25
98421113	AEC	Corporate Communication	20	20	40	40	1.5	–	--	80
98422114	AEC	Corporate Communication Lab	–	–	–	–	–	25	–	25
Total			120	120	240	340	14	250	125	955

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	
12111201	BSC	Probability, Statistics, and Differential Equations	2	1	--	30	15	--	45	90	3
12111202	BSC	Modern Physics	2	--	--	30	--	--	30	60	2
12121203	ESC	Engineering Graphics	2	--	--	30	--	--	30	60	2
12211204	PCC	Data Structure	3	--	--	45	--	--	45	90	3
12112205	BSCL	Modern Physics Lab	--	--	1	--	--	15	--	15	0.5
12122206	ESCL	Engineering Graphics Lab	--	--	2	--	--	30	--	30	1
12122207	ESCL	Modern Programming Paradigms Lab	2	--	2	30	--	30	--	60	2
12122208	ESCL	IDEA LAB -2 (Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
12212209	PCCL	Data Structure Lab	--	--	2	--	--	30	--	30	1
12412210	VSEC	Workshop -II	--	--	2	--	--	30	15	45	1.5
98441211	IKS	Indian Knowledge System	2	--	--	30	--	--	30	60	2
98462212	CC	NSS & Civil Defense	--	--	4	--	--	60	--	60	2
98471213	Audit Course	Audit Course	3	--	--	45	--	--	--	--	--
	Total		17	1	15	255	15	225	210	660	22

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."

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						Total
				In-Semester Assessments		End Sem Exam (ESE)	Exam Duration for Theory (in hrs)	Term Work	Practical & Oral	
			IAT-1	IAT-2	IAT-1 + IAT-2		End-Sem			
12111201	BSC	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	–	125
12111202	BSC	Modern physics	20	20	40	60	2.5	--	--	100
12121203	ESC	Engineering Graphics	20	20	40	60	2.5	--	--	100
12211204	PCC	Data Structure	20	20	40	60	2.5	--	--	100
12112205	BSCL	Modern Physics lab	--	--	--	--	--	25	–	25
12122206	ESCL	Engineering Graphics Lab	--	--	--	--	--	25	25	50
12122207	ESCL	Modern Programming Paradigms Lab	--	--	--	--	--	25	25	50
12122208	ESCL	IDEA LAB -2 (Innovation Design Engineering and Apply)	--	--	--	--	--	50	50	100
12212209	PCCL	Data Structure Lab	--	--	--	--	--	25	25	50
12412210	VSEC	Workshop -II	--	--	--	--	--	25	--	25
98441211	IKS	Indian Knowledge System	20	20	40	60	2.5	--	--	100
98462212	CC	NSS/Civil Defense	--	--	--	--	--	25	–	25
98471213	Audit Course	Audit Course								
Total			100	100	200	300	12.5	225	125	850

Note:

1) IKS and CC 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."

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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.

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	
12211301	PCC	Discrete Mathematics and Graph Theory	2	1	–	30	15	–	45	90	3
12211302	PCC	Analysis of Algorithm	3	--	--	45	--	--	45	90	3
12211303	PCC	Database Management System	3	--	–	45	--	--	45	90	3
12211304	PCC	Object Oriented Programming	3	–	–	45	--	--	45	90	3
12212305	PCCL	Integrated Lab - 1	–	--	2	--	--	30	--	30	1
12212306	PCCL	Object Oriented Programming Lab	–	--	2	--	--	30	--	30	1
9951137 WW	OE	Open Elective	2	--	–	30	--	--	30	60	2
98431308	Entrepreneurship	Entrepreneurship Development	2	--	–	30	--	--	30	60	2
98451309	Value Education course	Environmental Science	2	--	–	30	--	--	30	60	2
12812310	Community Engagement Project	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."

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	IAT-1 + IAT-2		End- Sem			
12211301	PCC	Discrete Mathematics and Graph Theory	20	20	40	60	2.5	25	–	125
12211302	PCC	Analysis of Algorithm	20	20	40	60	2.5	–	–	100
12211303	PCC	Database management system	20	20	40	60	2.5	–	–	100
12211304	PCC	Object Oriented Programming	20	20	40	60	2.5	–	–	100
12212305	PCCL	Integrated lab- 1	–	–	–	–	–	25	25	50
12212306	PCCL	Object Oriented Programming Lab	–	–	–	–	–	25	25	50
9951137W W	OE	Open Elective	–	–	–	–	–	25	–	25
98431308	Entrepreneurship	Entrepreneurship Development	–	–	–	–	–	25	–	25
98451309	Value education course	Environmental Science	20	20	40	60	2.5	–	–	100
12812310	Community Engagement Project	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	
12211401	PCC	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3
12211402	PCC	Software Engineering and Project Management	3	--	--	45	--	--	45	90	3
12211403	PCC	Microprocessor and Microcontroller	3	--	--	45	--	--	45	90	3
12212404	PCCL	Integrated Lab - 2	--	--	2	--	--	30	--	30	1
12212405	PCCL	IDEA LAB -4 (Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
12412406	VSEC	Full stack development	--	--	2	--	--	30	--	30	1
9931147WW	MDM	Multidisciplinary Minor	3	--	--	45	--	--	45	90	3
9931248WW	MDML	Multidisciplinary Minor	--	--	2	--	--	30	--	30	1
9951149WW	OE	Open Elective	2	--	--	30	--	--	30	60	2
98451410	VEC	Design Thinking	2	--	--	30	--	--	30	60	2
98431411	Entrepreneurship	Business Model Development	2	--	--	30	--	--	30	60	2
98471412	Audit Course	Audit Course	3	--	--	45	--	--	--	--	--

Total			21	1	8	315	15	120	285	690	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		IAT-1 + IAT-2	End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2			End-Sem			
12211401	PCC	Sampling Theory and Optimization	20	20	40	60	2.5	25	–	125
12211402	PCC	Software engineering and project management	20	20	40	60	2.5	–	–	100
12211403	PCC	Microprocessor and Microcontrollers	20	20	40	60	2.5	–	–	100
12212404	PCCL	Integrated Lab-2	–	–	–	–	–	25	25	50
12212405	PCCL	IDEA LAB - 4 (Innovation Design Engineering and Apply)	–	–	–	–	–	50	50	100
12412406	VSEC	Full stack development	–	–	–	–	–	25	25	50
9931147WW	MDM	Multidisciplinary Minor	20	20	40	60	2.5	–	–	100
9931248WW	MDML	Multidisciplinary Minor	–	–	–	–	–	25	25	50
9951149WW	OE	Open Elective	–	--	–	–	--	25	–	25
98451410	VEC	Design Thinking	20	20	40	60	2.5	–	–	100
98431411	Entrepreneurship	Business Model Development	–	--	–	–	--	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	CMC501	Theoretical Computer Science	3	-	-	3	-	-	3
PCC	CMC502	Software Engineering	3	-	-	3	-	-	3
PCC	CMC503	Computer Network	3	-	-	3	-	-	3
PCC	CMC504	Data Warehousing & Mining	3	-	-	3	-	-	3
PEC	CMC55W	Professional Elective Course-1	3	-	-	3	-	-	3
PCL	CML506	Software Engineering Lab	-	2	-	-	1	-	1
PCL	CML507	Computer Network Lab	-	2	-	-	1	-	1
PCL	CML508	Data Warehousing & Mining Lab	-	2	-	-	1	-	1
	CML509	Professional Communication & Ethics-II	-	2*+2	-	-	2	-	2
PCL	CML510	Mini Project – 2 A	-	4\$	-	-	2	-	2
Total			15	14	-	15	07	-	22

* 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.

CMC55W	Professional Elective Course – 1
CMC551	Probabilistic Graphical Models
CMC552	Internet Programming
CMC553	Advance Database Management System

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	IAT-1+IAT-2		End - Sem			
PCC	CMC501	Theoretical Computer Science	20	20	40	60	2.5	25	–	125
PCC	CMC502	Software Engineering	20	20	40	60	2.5	–	–	100
PCC	CMC503	Computer Network	20	20	40	60	2.5	–	–	100
PCC	CMC504	Data Warehousing & Mining	20	20	40	60	2.5	–	–	100
PEC	CMC55W	Professional Elective Course-1	20	20	40	60	2.5			100
PCL	CML506	Software Engineering Lab	–	–	–	–	–	25	25	50
PCL	CML507	Computer Network Lab	–	–	–	–	–	25	25	50
PCL	CML508	Data Warehousing & Mining Lab	–	–	–	–	–	25	25	50
	CML509	Professional Communication & Ethics-II	–	–	–	–	–	50	--	50
PCL	CML510	Mini Project – 2 A	–	–	–	–	–	25	25	50
Total			100	100	200	300	12.5	175	100	775

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	CMC601	System Programming & Compiler Construction	3	-	-	3		-	3
PCC	CMC602	Cryptography & System Security	3	-	-	3		-	3
PCC	CMC603	Mobile Computing	3	-	-	3		-	3
PCC	CMC604	Artificial Intelligence	3	-	-	3		-	3
PEC	CMC65W	Professional Elective Course – 2	3	-	-	3		-	3
PCL	CML606	System Programming & Compiler Construction Lab	-	2	-	-	1	-	1
PCL	CML607	Cryptography & System Security Lab	-	2	-	-	1	-	1
PCL	CML608	Mobile Computing Lab	-	2	-	-	1	-	1
PCL	CML609	Artificial Intelligence Lab	-	2	-	-	1	-	1
PCL	CML610	Skill base Lab Course: Cloud Computing	-	4	-	-	2	-	2
PCL	CML611	Mini Project Lab– 2 B	-	4\$	-	-	2	-	2
Total			15	16	-	15	08	-	23

\$ 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.

CMC65W	Professional Elective Course – 2
CMC651	Internet of Things
CMC652	Digital Signal & Image Processing
CMC653	Quantitative Analysis

Examination Scheme – TE Semester-VI

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			IAT-1+IAT-2			
PCC	CMC601	System Programming & Compiler Construction	20	20	40	60	2.5	-	-	100
PCC	CMC602	Cryptography & System Security	20	20	40	60	2.5	-	-	100
PCC	CMC603	Mobile Computing	20	20	40	60	2.5	-	-	100
PCC	CMC604	Artificial Intelligence	20	20	40	60	2.5	-	-	100
PEC	CMC65W	Professional Elective Course – 2	20	20	40	60	2.5	-	-	100
PCL	CML606	System Programming & Compiler Construction Lab	–	–	–	–	–	25	25	50
PCL	CML607	Cryptography & System Security Lab	–	–	–	–	–	25	--	25
PCL	CML608	Mobile Computing Lab	–	–	–	–	–	25	--	25
PCL	CML609	Artificial Intelligence Lab	–	–	–	–	–	25	25	50
PCL	CML610	Skill base Lab Course: Cloud Computing	–	–	–	–	–	50	25	75
PCL	CML611	Mini Project Lab– 2 B	–	–	–	–	–	25	25	50
Total			100	100	200	300	12.5	175	100	775

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	CMC701	Machine Learning	3	-	-	3	-	-	3
PCC	CMC702	Big Data Analytics	3	-	-	3	-	-	3
PEC	CMC73W	Professional Elective Course- 3	3	-	-	3	-	-	3
PEC	CMC74W	Professional Elective Course- 4	3	-	-	3	-	-	3
OE	OEC75W W	Open Elective - 1	3	-	-	3	-	-	3
PCL	CML706	Machine Learning Lab	-	2	-	-	1	-	1
PCL	CML707	Big Data Analytics Lab	-	2	-	-	1	-	1
PEC	CML78W	Professional Elective Course-3 Lab	-	2	-	-	1	-	1
PEC	CML79W	Professional Elective Course-4 Lab	-	2	-	-	1	-	1
PCL	CML710	Major Project I	-	4#	-	-	2	-	2
Total			15	12	-	15	6	-	21

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

CMC73W	Professional Elective Course – 3
CMC731	Machine Vision
CMC732	Quantum Computing
CMC733	Natural Language Processing

CMC74W	Professional Elective Course – 4
CMC741	Augmented & Virtual Reality
CMC742	Blockchain
CMC743	Information Retrieval

CML78W	Professional Elective Course – 3 Lab
CML781	Machine Vision Lab
CML782	Quantum Computing Lab
CML783	Natural Language Processing Lab

CML79W	Professional Elective Course – 4 Lab
CML791	Augmented & Virtual Reality Lab
CML792	Blockchain Lab
CML793	Information Retrieval Lab

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.

OEC75WW	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	IAT-1+IAT-2		End - Sem			
PCC	CMC701	Machine Learning	20	20	40	60	2.5	-	—	100
PCC	CMC702	Big Data Analytics	20	20	40	60	2.5	—	—	100
PEC	CMC73W	Professional Elective Course- 3	20	20	40	60	2.5	—	—	100
PEC	CMC74W	Professional Elective Course- 4	20	20	40	60	2.5	—	—	100
OE	OEC75WW	Open Elective - 1	20	20	40	60	2.5			100
PCL	CML706	Machine Learning Lab	—	—	—	—	—	25	25	50
PCL	CML707	Big Data Analytics Lab	—	—	—	—	—	25	25	50
PEC	CML78W	Professional Elective Course- 3 Lab	—	—	—	—	—	25	--	25
PEC	CML79W	Professional Elective Course- 4 Lab	—	—	—	—	—	25	--	25
PCL	CML710	Major Project I	—	—	—	—	—	50	25	75
Total			100	100	200	300	12.5	150	75	725

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	CMC801	Distributed Computing	3	-	-	3	-	-	3
PEC	CMC82W	Professional Elective Course – 5	3	-	-	3	-	-	3
PEC	CMC83W	Professional Elective Course – 6	3	-	-	3	-	-	3
OE	OEC84WW	Open Elective -2	3	-	-	3	-	-	3
PCL	CML805	Distributed Computing Lab	-	2	-	-	1	-	1
PEC	CMC86W	Professional Elective Course – 5 Lab	-	2	-	-	1	-	1
PEC	CMC87W	Professional Elective Course – 6 Lab	-	2	-	-	1	-	1
PCL	CML808	Major Project 2	-	6#	-	-	3	-	3
OJT	OJT899	Internship/ Apprenticeship	-	8	-	-	4	-	4
Total			12	20	-	12	10	-	22

#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

CMC82W	Professional Elective Course – 5
CMC821	Deep Learning
CMC822	Digital Forensics
CMC823	Applied Data Science

CMC83W	Professional Elective Course – 6
CMC831	Optimization in Machine Learning
CMC832	High Performance Computing
CMC833	Social Media Analytics

CML86W	Professional Elective Course – 5 Lab
CML861	Deep Learning Lab
CML862	Digital Forensics Lab
CML863	Applied Data Science Lab

CMC87W	Professional Elective Course – 6 Lab
CML871	Optimization in Machine Learning Lab
CML872	High Performance Computing Lab
CML873	Social Media Analytics Lab

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.

OEC84WW	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		End Sem Exam (ESE)	Exam Duration for Theory (in Hrs)				
			IAT-1	IAT-2		IAT-1+IAT-2	End - Sem			
PCC	CMC801	Distributed Computing	20	20	40	60	2.5	-	-	100
PEC	CMC82W	Professional Elective Course – 5	20	20	40	60	2.5	-	-	100
PEC	CMC83W	Professional Elective Course – 6	20	20	40	60	2.5	-	-	100
OE	OEC84W W	Open Elective -2	20	20	40	60	2.5	-	-	100
PCL	CML805	Distributed Computing Lab	-	-	-	-	-	25	25	50
PEC	CMC86W	Professional Elective Course – 5 Lab	-	-	-	-	-	25	25	50
PEC	CMC87W	Professional Elective Course – 6 Lab	-	-	-	-	-	25	25	50
PCL	CML808	Major Project 2	-	-	-	-	-	100	50	150
OJT	OJT899	Internship/ Apprenticeship	-	-	-	-	-	25	-	25
Total			80	80	160	240	10	200	125	725

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 Defense 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 Security Lab	Cyber Security Lab	Open Source Intelligence Lab	Multidisciplinary 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 Applicable:

	CS	IT	EXTC	ECS	MECH	CIVIL
Communication Engineering	✓	✓	--	✓	✓	✓
Internet of Technology	✓	✓	✓	✓	✓	✓
Electronics Engineering	✓	✓	✓	--	✓	✓
Mechanical Engineering	✓	✓	✓	✓	--	✓
Sustainability & Environment	✓	✓	✓	✓	✓	--
Information Technology	✓	--	✓	✓	✓	✓
Cyber Security	✓	✓	✓	✓	✓	✓
Computer Engineering	--	✓	✓	✓	✓	✓
Artificial Intelligence	✓	✓	✓	✓	✓	✓



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R-2025- All Branches

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

	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total.					
	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)

R-2025- All Branches

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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.



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R-2025- F.E Computer Engineering

F.E Syllabus

Semester-I



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R-2025- F.E Computer Engineering

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.



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- **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.
 - **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.



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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."



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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.”**



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R-2025- F.E Computer Engineering

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	
12111101	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-1	IAT-2	IAT-1+IAT-2					
12111101	Linear Algebra and Calculus	20	20	40	60	2.5	25	--	125

Rationale:

The topics of matrices and linear equations are fundamental in computer engineering for representing and solving problems involving circuit networks, 3D transformations in graphics, and systems of equations in programming logic. Eigenvalues and eigenvectors are widely used in stability analysis of dynamic systems, facial recognition, and data compression techniques like PCA in machine learning. Similarity and diagonalization simplify matrix computations and are especially useful in systems design and simulation tools where computational efficiency is crucial. Partial differentiation plays a key role in optimizing multivariable functions, commonly used in algorithm tuning, performance analysis, and training of machine learning models. Finally, analytic functions in complex variables provide critical tools for signal analysis, control system design, and solving boundary-value problems in electromagnetic field computations. Collectively, these mathematical foundations support a wide range of applications in computer engineering, from hardware modeling to software optimization.



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R-2025- F.E Computer Engineering

Course Objectives:

1. To introduce matrix operations and their applications in representing and manipulating data structures in computing.
2. To develop techniques to solve systems of linear equations that arise in algorithmic design, logic circuits, and numerical computation.
3. To understand eigenvalues and eigenvectors and their role in analyzing linear transformations and reducing data complexity.
4. To explore matrix similarity and diagonalization for simplifying computations in modeling and dynamic system simulation.
5. To understand partial derivatives in the context of multivariable optimization relevant to computing system parameters.
6. To introduce analytic functions of complex variables and their applications in signal processing and system analysis.

Course Outcomes:

1. Students will be able to apply matrix operations and use SCILAB to solve problems in computer graphics, data modeling, and graph-based algorithms.
2. Students will be able to solve and analyze systems of linear equations relevant and use SCILAB to memory allocation, logical constraints, and circuit analysis.
3. Students will be able to use eigenvalues and eigenvectors and use SCILAB in applications like machine learning (PCA), Google PageRank, and system behavior analysis.
4. Students will be able to diagonalize matrices and use SCILAB to solve problems in dynamic system modeling, recursive algorithms, and performance optimization.
5. Students will be able to apply partial differentiation and use SCILAB to optimize system performance, algorithm efficiency, and modeling in machine learning.
6. Students will be able to apply properties of analytic functions and use SCILAB in modeling signal behavior, frequency domain analysis, and digital filtering.



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R-2025- F.E Computer Engineering

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.

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	10	
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	10	



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		2. Linear Transformations. 3. Rank -Nullity theorems.		
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	10	
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.	10	
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.	10	



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		2. Euler's Theorem on Homogeneous functions with three independent variables. 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.	10	

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.



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4. Narayan S.: “Differential Calculus”, S.Chand Publications, 30th Ed., 2005.

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_appl/Applications/applications.html
2.	https://onlinelibrary.wiley.com/doi/10.1155/2016/4854759
3.	https://archive.nptel.ac.in/courses/111/108/111108066/

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4.	https://archive.nptel.ac.in/courses/111/104/111104092/

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 05 SCILAB tutorials** (including print out) and **at least 10** 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



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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	
12121102	Engineering Mechanics	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	IAT-1+IAT-2					
12121102	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.



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- 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

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

Mod ule 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	01 01	



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		Momentum, work-energy principle, impulse and 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: Equilibrium of connected bodies (beam and sphere), two force and three	07	CO3



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		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: - Derive and Analyze - Manual derivation of forward kinematics using D-H parameters	04 04	CO6



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		- 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		

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/



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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	
12121103	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	IAT-1+IAT-2					
12121103	Digital Logic & Computer Organization Architecture	20	20	40	60	2.5	--	--	100

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Rationale

This syllabus equips students with **computer fundamentals, digital logic design, computer organization, memory systems, arithmetic algorithms, and I/O organization** to develop accessible, inclusive, and sustainable technology solutions. It emphasizes building **digital literacy, design thinking, and problem-solving abilities** that enable learners to create affordable assistive devices, inclusive learning kits, and smart civic systems for **marginalized and differently abled communities**. By integrating **self-learning extensions, and real-world case studies** promotes **equitable access to technology**, and strengthens students' capacity to contribute to the **local digital economy**. Aligning with UNSDG 4 (Quality Education), UNSDG 8 (Decent Work), and UNSDG 10 (Reduced Inequalities) under the theme Digital Empowerment for All."

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



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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.
2. Design and evaluate combinational and sequential circuits including counters and shift registers.
3. Demonstrate understanding of computer architecture, control unit design, and instruction execution.
4. Analyze memory hierarchy, cache mapping techniques, and coherency mechanisms.
5. Perform arithmetic operations using Booth's algorithm, signed division, and IEEE 754 standards.
6. Compare and implement I/O systems using programmed I/O, interrupts, and DMA techniques.

Prerequisite: Boolean Algebra basics

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Boolean Algebra basics: Boolean Variables and Constants, Basic Operations, Boolean Laws & Properties, DeMorgan's Theorems, Standard Forms Canonical Forms, Boolean Function Reduction.	0	
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	

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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	

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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 Self-learning Topics: Comparison of all I/O methods. 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	

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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.



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Online References:

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

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		L	T	P	L	T	P	SL	Notional Learning Hour	
12121104	Internet Technology	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT - 1	IAT -2	IAT-1+ IAT-2					
12121104	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 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:

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. Students will be able to 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,

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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

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		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	05	CO4
		Self Learning Topics : XML Editors and Validation Is (e.g., Oxygen XML, XML Notepad), Explore lic APIs that return JSON (e.g., Open Weather, Hub, News APIs)	04	



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 Internet 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 services 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	



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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 Reference

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



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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	
12121105	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	IAT-1+IAT-2					
12121105	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

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proficiency in writing efficient, modular, and scalable code. Its relevance spans all engineering 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.

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- Understand and apply the fundamental concepts of object-oriented programming in C++, including classes, objects, encapsulation, constructors, and member functions to design modular programs.
- 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.
- 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.

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	

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		• 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	

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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	

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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 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,	7	
		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	7	

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		- Constructors and Destructors - Friend Functions, Inline Functions		
		Self-Learning Topics: - Explore syntax differences between C and C++ - 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)	7	
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	
		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	8	

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		Read and summarize advanced topics like Templates or Exception Handling		
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 - 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)	7	
		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.

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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.

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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	
12122106	Engineering Mechanics Lab	-	-	1	-	-	15	-	15	0.5

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	IAT 1+ IAT 2					
12122106	Engineering Mechanics Lab	--	--	--	--	--	25	25	50

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.

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



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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
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 laminas (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

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08	Equilibrium of beam for support reactions using C programming language	02	CO3

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.



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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	
12122107	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	IAT-1+ IAT-2				
12122107	Digital Logic & Computer Organization Architecture Lab	--	--	--	--	25	25	50

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.

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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)

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

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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
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 first 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.



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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.

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.



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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	
12122108	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	IAT-1+ IAT 2				
12122108	Internet Technology Lab	--	--	--	--	25	25	50

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.

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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 Aim: Use nslookup, dig, and test SSL/TLS via browser or openssl to explore DNS and HTTPS behavior.	2
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

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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 Aim: Understand the Figma workspace, tools, and navigation.	2
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

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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.)

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.



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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.

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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	
12122109	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	IAT-1+ IAT 2				
12122109	C and C++ Programmin g Lab	--	--	--	--	25	25	50

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



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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 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

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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 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.	2

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

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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.

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.



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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.



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Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credit (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
12122110	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	IAT-1+ IAT 2				
12122110	IDEA LAB - 1(Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

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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



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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.



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- 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**



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

*R-2025- F.E Computer Engineering***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)**



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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:

Criteria	Marks	Description
Subject Knowledge Application	8	Depth and accuracy of concept integration into the project



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Criteria	Marks	Description
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



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R-2025- F.E. CMPN Engineering

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	
12412111	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	IAT-1+ IAT-2				
12412111	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

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functional website using Google Sites.

- 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

- Able to understand basic components of electrical components.
- Able to demonstrate the process of PCB fabrication.
- Able to assembling and disassembling a personal computer.
- Able to solve common trouble shooting problem and common hardware issues.
- Able to navigate and utilize core google workspace and integrate google workspace tools into a google sites.
- 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, LO2
		Self- Learning		



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		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 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	6 4 4	LO3 LO4 LO5 LO6



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		● 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	
		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.
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



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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	
98461112	Universal Human Values	2	-	-	30		-	30	60	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -1	IAT - 2	IAT-1+ IAT-2					
98461112	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



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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 are to be discussed is universal, rational, and verifiable, hence leads to harmony.

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.



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Prerequisite: There is no prerequisite for this course.

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	4 4	CO2

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		resolution		
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



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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.	5	CO6
		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	

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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.

Online References:

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

Term Work: 25 Marks

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)



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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.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
98421113	Corporate Communication	1	-	-	15	-	-	15	30	1

		Theory					Term Work	Pract Exam	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+ IAT 2					
98421113	Corporate Communication	20	20	40	40	1.5	-	-	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 capitalist, strategic investors, potential clients, and everyday users. It helps to create a brand image and manage organization reputation

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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 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 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.

Prerequisite: Basic knowledge of English language

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DETAILED SYLLABUS:

[illegible]



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		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, 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 family members to adopt an impressive & open communication style.	2 2	CO3

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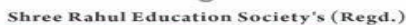
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IV	Text Interpretation Expertise	Reading Proficiency Intensive Reading, Extensive Reading Skimming, Scanning, SQ5R Method (Survey, Question, Reading, Recording, Recall, Review and Revise) Industry Related Articles and Report, .Summarizing text to Graphic 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)	2	
			2	

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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 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	
	Community	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		



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VI	Communication and Ethics	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
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

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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/

Test -I 20 marks

Test-II 20 Marks

Test -I - Independent speaking activity, where a student will deliver a 3 mins. prepared speech on a Technical topic related to his program and a two mins. Impromptu speech on general topics

Test -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.

End Semester Exam will be of 40 marks. It will be a written exam that will cover all six modules
Question Paper will comprise a total of five questions each carrying 10 marks. Q.1 will be compulsory and should cover the maximum contents of the syllabus. Remaining questions will be mixed in nature (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)

A total of four questions need to be answered.

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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	
98422114	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	IAT-2	IAT-1+ IAT 2				
98422114	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.
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

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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 for technical issues.

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
II	Active Listening	Detailed Oriented Listening and Applications: Technical or Business podcasts, Youtube lecture on academic		LO2



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		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	
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
		Practice Verbal Ability Test (GRE TOEFL and IELTS for grammar and vocabulary		

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IV	Text Interpretation Expertise	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
VI	Community Communication and Ethics	Local Area Visit (Nearby Banks ,Hospitals, stores, School , colleges Field Visits .Surveys ((Face to face, Kiosk /Mobile , QR Code/ SMS) & Feedback	4	LO6



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		Analysis and Report Writing ,Providing solutions for Technical issues		

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/

List of Experiments.

Sr. No	Name of Experiment	Hours

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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 form 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

Term Work - 25



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Experiments/Practicals

Six to Eight 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



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Semester-II



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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**.

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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.

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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



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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.



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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	
12111201	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- 2	IAT-1+ IAT 2					
12111201	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	--	125

Rationale

This foundational course introduces essential mathematical concepts and techniques critical to computer engineering. Beginning with differential equations of first order and higher order, students learn to model and analyze dynamic systems, which is vital for understanding hardware behavior, signal processing, and system control. The study of double integrals equips students with tools for evaluating multi-dimensional problems, relevant in areas such as image processing and physical modeling of computer components. The course also covers probability distributions and statistics, enabling students to handle uncertainty and analyze data effectively—skills crucial for areas like network traffic analysis, machine learning, and performance evaluation. The inclusion of statistical techniques introduces methods for data inference and decision making, supporting optimization and quality assurance in software and hardware development. Finally, the course teaches numerical methods that provide practical algorithms to approximate solutions for complex problems that cannot be solved analytically, a necessity in simulations, algorithm design, and real-time computing applications.



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Overall, this course provides computer engineering students with a strong mathematical foundation, blending theoretical understanding with practical applications to prepare them for advanced topics and real-world engineering challenges.

Course Objectives:

1. To introduce the formulation and solution of differential equations to model engineering systems.
2. To teach evaluation of double integrals over various regions to compute physical quantities.
3. To introduce probability models for random processes and events.
4. To develop skills to summarize and analyze data sets statistically.
5. To introduce inferential statistical methods for decision making.
6. To enable computational solution of mathematical problems through numerical techniques.

Course Outcomes:

1. Students will be able to solve differential equations to analyze dynamic behavior in computer hardware and networks.
2. Students will be able to evaluate double integrals to calculate parameters related to hardware design or image processing.
3. Students will be able to apply probability distributions to analyze uncertainties in computing systems.
4. Students will be able to interpret statistical measures to evaluate performance metrics of computer systems.
5. Students will be able to analyze data using hypothesis testing and regression to optimize software and hardware performance.
6. Students will be able to implement numerical methods to approximate solutions in algorithm design and simulations.

Prerequisite:



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

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.	10	
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:	10	



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		1. Rectification of curves. (Cartesian, Polar and Parametric) 2. Application of double integrals to compute Area and Mass of lamina.		
III	Probability Distribution	Discrete distribution: Poisson distribution	05	CO3
		Continuous distribution: Uniform, Exponential and Normal distributions.		
		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	10	
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	10	
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.	10	



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		4. Covariance 5. Sampling theory for quantitative and qualitative samples.		
VI	Numerical Methods	Numerical integration-by (a) Trapezoidal (b) Simpson's 1/3rd (c) Simpson's 3/8th rule (all without proof)	05	CO6
		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	10	

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.



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4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell

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

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



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Course Code	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					
		L	T	P	L	T	P	SL	Notional Learning Hour	Total Credits (C) (Notional Learning Hour/30)
12111202	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	IAT-1+ IAT 2						
12111202	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.
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.

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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.
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.



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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	Detailed 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. Basics of Quantum Computing, Comparison of Classical computing & Quantum computing, Concept of Qubits, Quantum Superposition Quantum Entanglement.	06	CO 1
		Self-learning Topics: Quantum Tunneling and real-life examples Operators in Quantum Mechanics (basic idea) Quantum States and Measurement concept	06	

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		Basic Quantum Gates (NOT, Hadamard, CNOT) Quantum Teleportation (concept only) Quantum Cryptography and secure communication		
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, Determination of wavelength of light using plane transmission grating and numerical,.	05	
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. Fiber optics: Structure of an optical fiber, Types: Single mode &	06	CO 3

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		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 learning and advanced computational methods.	04	
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	

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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	

Text Books:

1. A Text book of Engineering Physics -Dr. M. N. Avadhanulu, Dr. P. G. Kshirsagar, S. Chand, 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

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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/
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



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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	
12121203	Engineering Graphics	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	IAT-1+ IAT 2					
12121203	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.



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- 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.
- 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

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Text Books:

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.

References:

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.

Online References:

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/



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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	
12211204	Data Structure	3	--	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+ IAT 2					
12211204	Data Structure	20	20	40	60	2.5	--	--	100

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-



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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 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.		



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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 Double-Ended Queue (Deque).	8	CO1, CO2
		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,	9	



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		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.		CO1, CO2
		Self-learning Topics: Linked List 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.	9	CO1, CO2



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		B-tree: Searching, Insertion, Deletion from leaf node and non-leaf node. 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
		Self-learning Topics: Comparative Study and Implementation of		



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		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	10	

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



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Approach with C”, 2nd Edition, 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)



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12112205	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	IAT-1+ IAT-2				
12112205	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.



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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.



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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/



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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.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12122206	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	IAT-1+ IAT 2					
12122206	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.

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- 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.



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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	
12122207	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	IAT-1+ IAT 2				
12122207	Modern Programming Paradigms Lab	--	--	--	--	25	25	50

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.
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.

Prerequisite : Internet Technology, c & c++

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, Terminals, Compilers	4	LO1



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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	5	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	6	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	6	LO4



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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	5	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)	4	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.	4

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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 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.	5
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	6
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	6
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	5
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	4



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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.)



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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

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.



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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	
12122208	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	IAT-1+ IAT 2				
12122208	IDEA LAB - 2(Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

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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



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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**.



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- 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.
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



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Assessment Month	Weightage	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:

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



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Criteria	Marks	Description
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



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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	
12212209	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	IAT-1+ IAT 2				
12212209	Data Structure Lab	--	--	--	--	25	25	50

Lab Objectives:

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

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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
05	Array Implementation of Circular Queue.	2
06	Implement Singly Linked List.	2

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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.



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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.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12412210	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	IAT-1+ IAT 2				
12412210	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

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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.
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.	4	



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		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.		
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
		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:

Sr No	List of Experiments	Hrs.
01	Blinking LED with Node MCU.	6
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.	8



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Assessment for Term Work (25 marks)

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



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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)
98441211	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	IAT-1+ IAT-2					
98441211	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.



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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		



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		Technology in India.		
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 Bharata Muni, 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	5	CO6



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		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	
V	Contribution of Indian Scientist & Nobel Laureates	Baudhayan, Aryabhatta, 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 Self-Learning Topics: Indian Contributions to Global Science	5	CO5
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	



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R-2025- S.E (Sem III) All Branches

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.

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R-2025- S.E (Sem III) All Branches

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

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

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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	
98462212	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 Duratio n (in Hrs)			
		IAT- 1	IAT- 2	IAT-1+ IAT 2					
98462212	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.

Course Objectives:

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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,	6	Co1



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		Sustainable Development Goals		
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	10	CO6



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		numbers and response protocol, Evacuation techniques		
		Total	60	

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.



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S.E Syllabus Semester-III

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Theme: “Tech4Startup: Enabling Rural Entrepreneurship through Digital Tools in Maharashtra”

Aligned with SDG 4 (Quality Education) and SDG 9 (Industry, Innovation & Infrastructure).

Keywords: rural entrepreneurs, information gap, challenges, digital tools.

The theme "Tech4Startup: Enabling Rural Entrepreneurship through Digital Tools" in rural Maharashtra is a critical and multi-faceted area of focus, aiming to leverage technology for the economic empowerment and sustainable development of rural communities.

The theme directly aligns with and contributes significantly to the achievement of UN Sustainable Development Goal (SDG) 4: Quality Education, and SDG 9: Industry, Innovation & Infrastructure, within the specific context of rural Maharashtra.

Alignment with UNSDG 4: Quality Education

SDG 4 aims to "ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." "Tech4Startup" contributes to this by:

- **Digital Literacy and Skills Training:** For rural entrepreneurship to thrive, individuals need foundational digital literacy. This theme implies a focus on providing accessible and relevant training programs to rural communities in Maharashtra. This includes teaching them how to use smartphones, access the internet, navigate online platforms, use digital payment systems (like UPI), and understand basic e-commerce functionalities. This direct digital education empowers aspiring entrepreneurs with the fundamental knowledge to leverage technology for their businesses.
- **Business Skill Development through Digital Platforms:** Beyond basic literacy, "Tech4Startup" involves using digital tools to deliver specialized business education. This could include online courses, webinars, and digital modules on topics such as business planning, marketing (especially digital marketing and social media), financial management, supply chain optimization, and customer relationship management. This ensures that rural entrepreneurs gain the necessary skills to establish and grow sustainable ventures, accessible regardless of their geographical location.
- **Access to Information and Mentorship:** Digital tools facilitate access to a vast repository of information relevant to various industries and markets. Rural entrepreneurs can research market trends, identify gaps, learn about best practices, and connect with mentors or experts from urban centers or even globally. Online forums, professional networking platforms, and dedicated mentorship programs delivered digitally can bridge the knowledge gap and foster a culture of continuous learning.

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- **Removing Geographical Barriers to Learning:** Traditional educational infrastructure might be scarce in remote rural areas. Digital tools effectively overcome these geographical barriers, making quality education and skill development accessible to a wider audience, including women, youth, and other marginalized groups who may have limited mobility.

Alignment with UNSDG 9: Industry, Innovation & Infrastructure

SDG 9 focuses on "building resilient infrastructure, promoting inclusive and sustainable industrialization and fostering innovation." "Tech4Startup" directly contributes to this by:

- **Developing Digital Infrastructure:** The success of "Tech4Startup" hinges on robust digital infrastructure in rural Maharashtra. This includes ensuring reliable internet connectivity (broadband, mobile data), access to affordable digital devices, and the establishment of community digital centers. Initiatives like the government's BharatNet project are crucial to laying this foundation, enabling rural entrepreneurs to connect to the global digital economy.
- **Fostering Innovation in Rural Industries:** Digital tools empower rural entrepreneurs to innovate in their products, processes, and business models. This could involve using data analytics to understand market demand, adopting new agricultural technologies (Agri-Tech), implementing efficient production techniques, or creating unique digital marketing strategies for local products. It encourages a shift from traditional practices to more efficient and competitive approaches.
- **Promoting Inclusive Industrialization:** By enabling rural entrepreneurship, the theme contributes to inclusive industrialization. It means empowering small-scale and cottage industries, handicrafts, agro-processing units, and service-based businesses in rural areas to scale up and reach wider markets. Digital platforms (e-commerce, social media marketing) are vital for these businesses to overcome limitations of physical storefronts and localized demand.
- **Creating Resilient Business Ecosystems:** Digital tools enhance the resilience of rural businesses by diversifying market access (online sales reduce reliance on local markets), streamlining operations, and improving financial inclusion (digital payments, access to credit). It allows entrepreneurs to adapt to changing market conditions and economic shocks more effectively.
- **Stimulating Local Economic Growth and Job Creation:** Rural startups, powered by digital tools, can create employment opportunities within their communities, reducing rural-urban migration. By fostering a vibrant entrepreneurial ecosystem, the theme encourages local value creation, leading to sustainable economic growth in Maharashtra's rural regions. This also attracts investments and develops ancillary services.



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Problem Statements:

1. "Significant information gap faced by rural entrepreneurs in Maharashtra regarding crucial government schemes and the practical benefits of digital tools, ensuring this information is delivered intuitively and culturally relevantly in local languages."
2. "Inefficiencies and high costs associated with last-mile delivery and pickup of goods for rural entrepreneurs in remote areas of Maharashtra, given the fragmented nature of local transport options."
3. "The challenges faced by rural entrepreneurs in Maharashtra in effectively showcasing their unique products and services, establishing credible branding, ensuring quality assurance, and managing last-mile logistics to access broader national and international markets."
4. "There is no real-time data-driven support system to help rural entrepreneurs in Maharashtra make informed decisions on production, pricing, and distribution."
5. "Digital content and training materials relevant to rural entrepreneurship are often not available or easily understandable in local languages and dialects prevalent across Maharashtra's diverse rural communities."
6. "Women in rural areas of Maharashtra face barriers in accessing digital tools for entrepreneurship due to societal norms and lack of tailored training."



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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	
12211301	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-1	IAT-2	IAT-1+ IAT-2					
12211301	Discrete Mathematics and Graph Theory	20	20	40	60	2.5	25	--	125

Rationale:

Elementary Number Theory provides the mathematical foundation for cryptography and security algorithms essential in computer engineering, such as RSA encryption. Functions and Mathematical Relations help model data structures, database schemas, and finite state machines used in software and hardware design. The Fundamental Principle of Counting equips students with combinatorial techniques crucial for analyzing algorithms, calculating IP addressing schemes, and designing logic circuits. Algebraic Structures like groups, rings, and fields underpin error detection, hashing functions, and cryptographic protocols. Graph Theory enables modeling of networks, dependency graphs, and routing algorithms vital for computer networks and compiler design. Finally, Coding Theory teaches methods for error detection and correction, enhancing data



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reliability in communication systems and memory storage. Together, these topics build a rigorous mathematical framework for solving practical problems in computer engineering.

Course Objectives:

1. To understand number theory concepts such as divisibility, primes, and modular arithmetic.
2. To explain types of functions and relations and their properties for use in system modeling.
3. To describe and apply combinatorial techniques to solve basic counting problems.
4. To understand algebraic structures and their applications in computing.
5. To explain fundamental graph theory concepts and their role in modeling networks.
6. To understand principles of error detection and correction using coding theory.

Course Outcomes:

1. Students will be able to apply modular arithmetic to solve problems like cryptographic key generation in RSA encryption.
2. Students will be able to analyze function mappings and relations in database schema design and finite automata transitions.
3. Students will be able to solve real-world problems such as determining the number of IP address allocations or password combinations.
4. Students will be able to use group and field theory to design reliable hashing algorithms and error-detecting codes.
5. Students will be able to model and analyze computer networks, routing algorithms, and dependency graphs using graph theory.
6. Students will be able to apply Hamming codes and parity checks to enhance data reliability in memory systems and communication protocols.

Prerequisite:

1. Definition of sets, Venn diagrams, complements, cartesian products, power sets.
2. Propositions and Logical operations, Truth tables, Equivalence, Implications



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DETAILED SYLLABUS

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.	10	
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.	10	
		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. 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.		
		Basic Counting Principle-Sum Rule, Product Rule.		



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III	Fundamental Principle of Counting	Inclusion-Exclusion Principle and Pigeonhole Principle	05	CO3
		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.	10	
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.	10	
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.		
		Euler and Hamiltonian Graphs, Planar Graph, Cut Set, Cut Vertex.		
		Trees and application of trees.		
		Self-learning Topics:	10	



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		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.		
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	10	

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.
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.



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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

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.

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2. Class Tutorials on entire syllabus 10 marks.
3. Mini Project 10 marks.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12211302	Analysis of Algorithm	3	--	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT- 1	IAT -2	IAT- 1+IAT -2					
12211302	Analysis of Algorithm	20	20	40	60	2.5	--	--	100

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Rationale:

The Analysis of Algorithm syllabus equips students with essential algorithmic skills to solve real-world problems efficiently. Aligned with the theme **“Tech4Startup: Enabling Rural Entrepreneurship through Digital Tools in Maharashtra”**, it emphasizes practical applications like rural logistics, scheduling, and search systems. Through modules on Greedy, Dynamic, and Graph algorithms, students learn to build digital tools that support rural innovation. The course fosters a problem-solving mindset aligned with **SDG 4 and SDG 9**.

Course Objectives:

1. Awareness of how algorithm performance affects time and space efficiency.
2. Exposure to Divide and Conquer techniques for solving common computational problems.
3. Creation of logic for solving rural logistics and task scheduling using Greedy methods.
4. Understanding of Dynamic Programming concepts for building planning and support tools.
5. Usage of Backtracking and Branch & Bound methods for scheduling and resource allocation in rural applications.
6. Application of string matching techniques for building simple, local-language search functions in digital tools.

Course Outcomes:

1. **Analyze** algorithm performance using time and space complexity.
2. **Implement** Divide and Conquer methods to improve rural data processing.
3. **Design** Greedy algorithms for optimizing rural logistics and scheduling.
4. **Develop** Dynamic Programming solutions for rural planning tasks.



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5. **Apply** Backtracking and Branch & Bound for scheduling and resource planning.
6. **Use** String Matching to build search features for rural digital apps.

Prerequisite: Data Structure Concepts

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Arrays, Queues, Graphs, Sorting and Searching, Recursion		
I	Introduction to Algorithms	Performance analysis- Master Method, space, and time complexity Growth of function, Big- Oh, Omega Theta Notation Mathematical background for algorithm analysis, Recursion tree method, Analysis of selection sort, insertion sort.	7	CO1
		Self-learning Topics: Complexity class: Definition of P, NP, NP-Hard, NP-Complete, substitution method, Compare the time taken by Bubble Sort Vs Insertion Sort for sorting 50 product prices from a local market and Analyze which sorting is better based on input	7	

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		size.		
II	Divide and Conquer Approach	General method, Merge sort, Quick sort, Analysis of Binary search., Finding minimum and maximum algorithms and their Analysis.	7	CO2
		Self-learning Topics: , Strassen's Algorithm, Build a “Product Search Tool” where users can search for an item in a sorted price list using Binary Search (Apply recursive problem-solving for fast searching.)	6	
III	Greedy Method Approach	General Method, Single source shortest path: Dijkstra Algorithm, Fractional Knapsack problem, Minimum cost spanning trees: Kruskal and Prim’s algorithms	8	CO3
		Self-learning Topics: Job sequencing with deadlines, BFS and DFS Graph traversal techniques, design a route planner that finds the shortest path from farms to nearby villages using Dijkstra's algorithm (Solve basic optimization problems)	7	

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IV	Dynamic Programming Approach	General Method, Multistage graphs, all pair shortest path: Floyd Warshall Algorithm, 0/1 knapsack Problem, Travelling Salesperson problem, Longest common subsequence.	10	CO4
		Self-learning Topics: Bellman Ford Algorithm, assembly-line scheduling problem, solve a “Grain Storage Optimization” problem using 0/1 Knapsack – decide which grain bags to load in a truck with limited weight capacity (Practice decision-making using memory-based optimization.).	10	
V	Backtracking and Branch and Bound	General Method, Backtracking: N-queen problem, Sum of subsets, Graph coloring. Branch and Bound: Travelling Salesperson Problem, 15 Puzzle problem.	8	CO5
		Self-learning Topics: Create a simple class timetable scheduler using Backtracking, ensuring no teacher is double-booked.	8	

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		(Understand constraint-based problem-solving.)		
VI	String Matching Algorithms	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm.	5	CO6
		Self-learning Topics: Build a Marathi/vernacular search tool to help farmers find specific training videos or articles on pest control, using KMP string matching.	7	

Text Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd Edition, PHI Publication 2005
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. “Fundamentals of computer algorithms” University Press.

References:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI

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Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms

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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	
12211303	Database Management System	3	-	-	45	--	--	45	90	3

		Theory					Ter m work	Pract / Oral	Tota l
		Internal Assessment			End Sem Exa m	Exam Durati on (in Hrs)			
		IAT -1	IAT- 2	IAT-1+ IAT-2					
12211303	Database Management System	20	20	40	60	2.5	--	--	100

Rationale:

This course introduces students to the fundamentals of database systems essential for building data-driven applications. It equips learners with practical skills in data modeling, SQL, normalization, and modern database technologies. The focus is on designing scalable, reliable solutions to support rural entrepreneurship through digital tools.

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Course Objectives:

1. To introduce fundamental database concepts and demonstrate their role in building digital solutions for rural entrepreneurship.
2. To enable students to model data using Entity-Relationship and relational models tailored to rural enterprise needs.
3. To develop skills in Structured Query Language (SQL) for creating, retrieving, and managing data in digital applications.
4. To explain the principles of data normalization and guide students in designing optimized, consistent databases.
5. To impart knowledge of transaction management, concurrency control, and recovery for reliable digital platforms.
6. To expose students to emerging database technologies like NoSQL and Big Data for scalable rural tech solutions.

Course Outcomes:

1. Identify and describe core database concepts relevant to rural digital systems.
2. Design ER and relational models based on rural entrepreneurship case studies.
3. Develop SQL queries to manage and retrieve data for rural enterprise applications.
4. Apply normalization techniques to optimize rural business databases.
5. Analyze transaction handling and concurrency control in rural tech environments.
6. Create scalable database-driven solutions using emerging technologies for rural entrepreneurship.

Prerequisite: Programming Fundamentals, Computer Fundamentals, Discrete Structures

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of computer systems, data types, file systems, data vs. information, intro to software tools like MS Excel/Google Sheets	-	
I	Fundamentals of Data	Introduction to databases and their applications, Characteristics of databases, DBMS architecture, ACID properties, The	6	CO1



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	Modelling & E-R Design	Entity-Relationship (ER) model, Entity types: weak and strong entity sets, Types of attributes and keys, Relationship constraints: cardinality and participation, Extended Entity-Relationship (EER) model: generalization, specialization, aggregation.		
		Self-learning Topics: Design an ER model for a real-time rural startup case study, Map use cases to entities and relationships, Investigate real-world use of databases in rural entrepreneurship platforms.	6	
II	Relational Model and Relational Algebra	Relational model concepts, Concepts of keys in relational model, Mapping ER to relational model, Relational algebra operations: select, project, union, set difference, Cartesian product, rename, join operations (theta, equi, natural), Use of relational algebra in query formulation	8	CO2
		Self-learning Topics: Design relational schemas for a rural enterprise information system, Practice relational algebra queries using real-life rural datasets, Compare different join operations using case-based examples, Explore tools that visualize relational algebra execution.	8	
III	Structured Query Language (SQL)	Introduction to SQL, DDL, DML, DCL commands, SQL queries for data retrieval, Constraints and integrity rules, Joins and subqueries, Aggregation and grouping, Views and indexing, SQL use-cases for rural data systems like inventory, payments, and orders.	8	CO3
		Self-learning Topics: Write SQL queries for a rural startup's digital backend (customer, product, order), Create views and test query optimization, Design and test constraints for data accuracy, Practice advanced SQL on open-source database tools	8	

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IV	Normalization and Database Design	Functional dependencies, Types of anomalies, First, Second, Third and Boyce-Codd Normal Forms (1NF, 2NF, 3NF, BCNF), Multi-valued dependencies and 4NF (overview), Database design approach, Case studies for rural entrepreneurship data organization.	7	CO4
		Self-learning Topics: Normalize datasets from a rural entrepreneurship domain, Analyze real-world database structures for redundancy and optimization, Redesign a denormalized rural enterprise schema, Explore online tools for visual database modeling.	7	
V	Transaction Management and Concurrency Control	Transaction concepts, States of transactions, Serializability and schedules, Concurrency control protocols (2PL, Timestamp-based), Deadlock handling, Recovery concepts, Use of transactions in digital payment platforms used in rural setups (e.g., UPI, microcredit systems).	8	CO5
		Self-learning Topics: Model concurrent transactions in rural order-processing systems, Simulate conflicts and deadlocks in sample scenarios, Explore open-source database engines with transaction logs, Analyze transaction case studies from fintech and rural startups.	8	
VI	Introduction to Modern Databases	NoSQL databases overview (Document, Column, Key-Value stores), Introduction to Big Data and Hadoop ecosystem, Role of databases in AI/ML integration, Case study: database backends in e-commerce and logistics platforms for rural businesses, Data-driven decision making and dashboards.	8	CO6
		Self-learning Topics: Explore NoSQL tools (MongoDB, Firebase) using rural product catalogs, Create mock dashboards for rural entrepreneurs using Power BI or Google Data Studio, Review	8	



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		government digital initiatives for rural entrepreneurship (e.g., PMGDISHA), Design a lightweight data management solution for a rural startup.		

Text Books:

1. Elmasri and Navathe, *Fundamentals of Database Systems*, 7th Edition, Pearson Education
2. Korth, Silberchatz, Sudarshan, *Database System Concepts*, 7th Edition, McGraw Hill
3. Raghu Ramakrishnan and Johannes Gehrke, *Database Management Systems*, 3rd Edition, Tata McGraw Hill

References:

1. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, *Mastering Cloud Computing*, Tata McGraw Hill Education
2. Pramod J. Sadalage and Martin Fowler, *NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence*, Addison-Wesley
3. C.J. Date, *An Introduction to Database Systems*, 8th Edition, Pearson Education
4. Mark L. Gillenson, *Fundamentals of Database Management Systems*, Wiley

Online References:

Sr. No.	Website Name
1	NPTEL Lecture Series: Database Management system By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay IIT Kharagpur
2	https://www.classcentral.com/course/swayam-database-management-system-9914
3	https://www.mooc-list.com/tags/dbms



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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	
12211304	Object Oriented Programming	3	-	-	45	-	-	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -1	IAT -2	IAT- 1+ IAT-2					
12211304	Object Oriented Programming	20	20	40	60	2.5	-	-	100

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Rationale:

The Object Oriented Programming syllabus empowers learners to develop strong programming foundations essential for building digital solutions that can drive **rural entrepreneurship in Maharashtra under the Tech4Startup initiative**. By teaching structured and object-oriented programming concepts, it enables the creation of reliable, maintainable software tools that support small businesses, digital literacy, and automation. The course directly contributes to **SDG 4** by enhancing access to quality technical education, and to **SDG 9** by fostering innovation and promoting technology-based infrastructure development in underserved regions.

Course Objectives:

1. Explore the foundational concepts of Java and code structured programs using data types, operators, control structures, and input/output mechanisms.
2. Construct modular applications by applying object-oriented principles through classes, objects, arrays, and string handling techniques.
3. Design extensible Java programs by applying inheritance, interface implementation, and package structuring to promote code reusability and scalability.
4. Formulate robust strategies for handling runtime errors using Java's exception handling mechanisms to ensure program reliability.
5. Configure concurrent Java applications using multithreading concepts to achieve responsive and efficient program execution.
6. Integrate Swing-based GUI components with JDBC to create interactive and data-driven desktop applications.

Course Outcomes:

1. Students will be able to implement basic Java programs using appropriate syntax, logic, and programming constructs for real-world problem-solving.
2. Students will be able to develop reusable and organized Java applications using constructors, arrays, and string classes.
3. Students will be able to synthesize and deploy Java applications that utilize inheritance hierarchies, interface-based design, and modular code packaging.



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- Students will be able to apply structured exception handling constructs (try, catch, throw, throws, and finally) to manage application errors effectively.
- Students will be able to develop multithreaded Java programs using thread classes, synchronization techniques, and concurrency management tools.
- Students will be able to construct and demonstrate Java applications that combine user interfaces with backend database operations for real-world use cases.

Prerequisite: Structured Programming Approach or knowledge of any programming language

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Structured Programming Approach or knowledge of any programming language		
I	Introduction to Java Programming.	Fundamentals of Java Programming: Overview of procedure and object-oriented programming, Features of Java, Java Virtual Machine Principles of OOP: Object, Class, Encapsulation, Abstraction, Inheritance, Polymorphism Basic Constructs: Constants, variables and data types, Wrapper classes, Operators and Expressions, Type conversion and casting	6	CO1



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		Input & Output in Java: command line arguments, BufferedReader class and Scanner class.		
		Self-learning Topics: Branching and looping: if, if-else, nested if-else, if-else-if ladder, switch-case, break, continue, for loop, while loop, and do-while loop.	6	
II	Classes and Objects, Arrays and Strings	Access specifiers, static and non-static members, Passing and returning variables and references, Method Overloading	9	CO2
		Arrays, Array of Objects, Strings (String and StringBuffer classes)		
		Constructors: Default, Parameterized Constructors, copy constructor and Constructor overloading.		
		Self-learning Topics: Heap Memory: Structure, object allocation, object promotion Stack Memory: Function call management, local variables, reference storage, stack overflow Method Area: Class metadata, static data, constant pool, concept of Metaspace	9	

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		Active Object and Active Reference: Object reachability and reference tracking Inactive Object and Inactive Reference: Conditions for object inactivity, use of null references Garbage Collector: Concept, types (Serial, Parallel, CMS, G1), phases (Mark, Sweep, Compact), GC tuning basics		
III	Inheritance, Interface and Packages	Inheritance Basics, Types of Inheritance in Java, Concept of Super and sub class, inheriting Data members and Methods, Role of Constructors in inheritance, making methods and classes final, Method overriding, Dynamic Method Dispatch, Abstract classes and methods. Defining an interface, extending interfaces, implementing interfaces, accessing implementations through interface references, Interfaces vs. Abstract classes Packages – Steps for defining, creating and accessing a Package, importing packages, Making JAR Files for Library Packages, java.util.Vector	9	CO3



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		Self-learning Topics: Constructor Chaining and Object Initialization, Memory Allocation for Inherited Objects, Stack and Heap Usage in Inheritance Contexts, Dynamic Binding and Method Overriding, Garbage Collection in Inherited Class Structures, Making JAR Files for Library Packages.	9	
IV	Exception Handling	Define Exception, advantages of exception handling, the classification of exceptions-exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, userdefined exception classes (creating own exception subclasses)	7	CO4
		Self-learning Topics: Impact of Exception Handling on Performance: Performance considerations, benchmarking exception-heavy code. Using Assertions vs. Exceptions: When to use assertions for validation and exceptions for error handling.	7	
V	Multithreading	Need of Multithreading, Java thread Model, thread Life-Cycle, thread class Methods, Daemon Threads Implementing Runnable, extending thread, synchronizing threads, synchronized Statement, Critical Factor in Thread –Deadlock	7	CO5

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		Self-learning Topics: Java Concurrency, Utilities (java.util.concurrent package), Volatile Keyword and Memory Consistency, Thread Local Storage, Atomic Variables and Locks, Fork/Join Framework, Handling Exceptions in Threads.	7	
VI	GUI programming in JAVA	SWING Programming: Swing Components and Containers, Swing Packages, A Simple Swing Application, Designing Swing GUI Application and Event handling. JDBC Introduction, JDBC Architecture, Types of JDBC Drivers, The Connectivity Model, The java.sql package, Navigating the ResultSet object's contents, Manipulating records of a ResultSet object through User Interface, The JDBC Exception classes, Database Connectivity, Data Manipulation (using Prepared Statements, Joins, Transactions, Stored Procedures), Data navigation.	7	CO6
		Self-learning Topics: Application Themes for Self- Development: Health Tracker System (SDG 3: Good Health and Well-being), Student Quiz & Feedback App (SDG 4: Quality Education), Water Usage Logger (SDG 6: Clean Water and	7	

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		Sanitation) Waste Collection Feedback App (SDG 11: Sustainable Cities), Eco- Friendly Product Inventory System (SDG 12: Responsible Consumption)		

Text Books:

1. Herbert Schildt, "Java-The Complete Reference", Thirteenth Edition, Tata McGraw Hill Publication
2. E. Balguruswamy, "Programming with java A primer", Seventh edition, Tata McGraw Hill Publication
3. Dr.G.T.Thampi, Junaid Khateeb,"Computer Programming in Java", Wiley Publication.

References:

1. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press
2. H. M.Deitel, P. J. Deitel, S. E. Santry, "Advanced Java 2 Platform How to Program" Prentice Hall
3. Jaime Nino, Frederick A. Hosch, "An introduction to Programming and Object Oriented Design using Java", Wiley Student Edition.

Online References:

Sr. No.	Website Name
1	https://www.w3schools.com/java/
2	https://www.programiz.com/java-programming
3	https://docs.oracle.com/javase/tutorial/

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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	
12212305	Integrated Lab- 1	--	--	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	IAT-1+ IAT-2				
12212305	Integrated Lab - 1	--	--	--	--	25	25	50

Lab Objectives:

1. Implement and compare the performance of fundamental sorting and searching algorithms.
2. Apply algorithmic techniques like Divide and Conquer, Greedy, and Dynamic

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- Programming to solve practical problems.
3. Develop solutions for rural network routing and scheduling problems using graph and backtracking algorithms.
 4. Design and model databases for rural entrepreneurship scenarios using ER diagrams and normalization.
 5. Write and execute SQL queries to manage and analyze data in rural business applications.
 6. Explore NoSQL databases and visualization tools to support data management and decision-making in rural enterprises.

Lab Outcomes:

- 1) **Implement** and **test** classical algorithms (Insertion, Selection, Quick, Merge Sort) and measure their time complexities.
- 2) **Analyze** and **solve** practical problems using advanced algorithms (Dijkstra's, Longest Common Subsequence, N-Queens) applied to rural contexts.
- 3) **Design** and **evaluate** graph-based and backtracking solutions for routing and scheduling challenges in rural systems.
- 4) **Create** ER diagrams and convert them into normalized relational schemas tailored to rural business requirements.
- 5) **Develop** and **analyze** complex SQL queries for effective data extraction and manipulation in rural enterprise databases.
- 6) **Evaluate** transaction control, concurrency, NoSQL implementation, and data visualization techniques for enhancing rural business intelligence.

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List of Experiments.

Sr No	List of Experiments	Hrs
01	To implement a program for Insertion sort and Selection sort. Also find its complexity.	2
02	To implement Quick Sort and Merge Sort Algorithm using Divide and Conquer and find its complexity.	2
03	To implement Min-Max Algorithm using Divide and Conquer and find its complexity.	2
04	To implement single Source Shortest Path using Dijkstra's algorithm using Greedy Approach.	2
05	Designing Digital Routing Paths in Rural Networks Using BFS and DFS Graph Traversal Algorithms.	2
06	To implement Longest Common Subsequence Algorithm using Dynamic Approach.	2
07	Scheduling Village Workshops or Health Camps Using N-Queens Algorithm to Avoid Double-Booking.	2
08	To implement Knuth Morris Pratt String Matching Algorithm.	2
09	Design an ER diagram for a rural entrepreneurship use case.	2
10	Map an ER model to relational schema and normalize it.	2
11	Implement SQL DDL and DML for a rural business application.	2
12	Write SQL queries to extract and analyze rural business data.	2
13	Simulate transactions with concurrency control in a rural inventory system.	2
14	Create and test a NoSQL database for a rural product catalog.	2
15	Design a data dashboard for a rural startup using Power BI or Google Data Studio.	2

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Sr No	List of Assignments / Tutorials	Hrs.
01	Assignment covers the topics from first three modules of Analysis of Algorithms :Introduction to algorithms, Divide & Conquer Approach, Greedy Approach	2
02	Assignment covers the topics from Last three modules of Analysis of Algorithms : Dynamic Programming, Backtracking & Branch and Bound, String Matching	2
03	Assignment covers the topics from first three modules of Database Management System :Fundamentals of Data Modelling & E-R Design, Relational Model and Relational Algebra, Structured Query Language (SQL)	2
04	Assignment covers the topics from last three modules of Database Management System : Normalization and Database Design, Transaction Management and Concurrency Control, Introduction to Modern Databases	2

Text Books:

1. T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, “Introduction to algorithms”, 2nd Edition, PHI Publication 2005
2. Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. “Fundamentals of computer algorithms” University Press.
3. Elmasri and Navathe, Fundamentals of Database Systems, 7th Edition, Pearson Education

References:

1. Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, “Algorithms”, Tata McGraw- Hill Edition.
2. S. K. Basu, “Design Methods and Analysis of Algorithm”, PHI
3. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill Education

Online Resources:



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Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/106/106106131/
2.	https://swayam.gov.in/nd1_noc19_cs47/preview
3.	https://www.coursera.org/specializations/algorithms
4.	https://www.mooc-list.com/tags/algorithms
5.	NPTEL Lecture Series: Database Management system By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay IIT Kharagpur

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.



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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	
12212306	Object Oriented 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	IAT-1+ IAT-2				
12212306	Object Oriented Programming Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Introduce basic Java syntax, data types, and standard input/output operations.
2. Develop skills in applying object-oriented programming concepts such as method overloading, inheritance, and packages.
3. Explore exception handling techniques to write robust and error-tolerant programs.
4. Implement multithreading and synchronization concepts for concurrent Java applications.
5. Create interactive user interfaces using Swing components for desktop applications.

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6. Demonstrate database connectivity using JDBC for performing basic CRUD operation.

Lab Outcomes:

1. **Identify** and **apply** fundamental Java constructs for input/output and string manipulation.
2. **Construct** object-oriented programs demonstrating inheritance, overloading, and modular design.
3. **Implement** exception handling mechanisms to manage runtime errors effectively.
4. **Develop** multithreaded applications demonstrating thread creation and synchronization.
5. **Build** interactive GUI applications using Swing components.
6. **Perform** database operations using JDBC for data retrieval and manipulation.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Write a Java program to understand how to accept input using Scanner or BufferedReader and print output using System.out.println statement.	2
02	Write a java program to test whether string is palindrome or not	2
03	Write a java program to count number of vowels and consonants from the given strings	2
04	Write a Java program to demonstrate Method overloading	2
05	Write a java program to demonstrate Array and Vectors operations	2
06	Write a java programs to add n strings in a vector array. Input new string and check whether it is present in the vector. If it is present delete it otherwise add it to the vector.	2
07	Write a java programs to demonstrate hierarchical inheritance	2
08	Write a java program to demonstrate Modules and packages	2

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09	Write java programs to demonstrate Exception handling using try, catch, throw, throws and finally statements.	2
10	Write java program to create a user defined Exception class known as PayOutOfBoundsException	2
11	Write java programs to create user defined threads by extending thread class and by implementing runnable.	2
12	Write java program to implement the concept of Thread Synchronization	2
13	Write a Java program to implement Swing components namely Buttons, JLabels, Checkboxes, Radio Buttons, JScrollPane, JList, JComboBox, Trees, Tables Scroll pane Menus and Toolbars to design interactive GUI.	2
14	Write a Java program using JDBC to connect to a MySQL (or SQLite) database, retrieve all records from a simple table (e.g., students with fields like id, name, marks), and display the records in the console.	2
15	Write a Java program that connects to the same database and performs: Insert a new student record into the students table using PreparedStatement, Update the marks of an existing student identified by ID.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three modules of Object Oriented Programming Language: Introduction to Java Programming, Classes and Objects, Arrays and Strings, Inheritance, Interface and Packages	2
02	Assignment covers the topics from last three modules of Object Oriented Programming Language: Exception Handling, Multithreading , GUI Programming in JAVA.	2

Text Books:

1. Herbert Schildt, “Java - The Complete Reference”, **Thirteenth Edition**, McGraw



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Hill Publication, 2023.

2. E. Balaguruswamy, "Programming with Java: A Primer", Seventh Edition, Tata McGraw Hill Publication (2023).
3. Star EduSolutions, "Learn to Master Java", Paperback, 1st Edition, Star EduSolutions Publication.

References:

1. Java 8 Programming Black Book", Dreamtech Press, 1st Edition (2015).
2. H. M. Deitel, P. J. Deitel, S. E. Santry, "Advanced Java 2 Platform How to Program", Prentice Hall, 1st Edition (September 28, 2001)
3. Jaime Niño, Frederick A. Hosch, "An Introduction to Programming and Object-Oriented Design Using Java", Wiley Student Edition, 3rd Edition (February 4, 2008).

Online Resources:

Sr. No.	Website Name
1	https://www.codestepbystep.com/problem/list/java
2	https://www.programiz.com/java-programming
3	https://www.includehelp.com/java-programs.aspx

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Teaching Scheme (Contact Hours Per Semester)					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
9951137WW	Open Elective	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	IAT-1+IAT-2					
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)

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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	
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	IAT-1+IAT-2					
98431308	Entrepreneur -ship 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.

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.

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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
		Self-learning Topics: Evolution of Indian startup ecosystem post-2010 Case Study: Nirma – A middle-class entrepreneur revolutionizing detergents.	4	



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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. Intellectual Property Rights (IPR) & Patents	6	CO4
		Self-learning Topics: DPIIT recognition process and types of funding Case Study: Paytm – From Wallet to IPO: Funding journey	6	



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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	
Total			30	

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 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:

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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)



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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	IAT-1+IAT -2					
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.

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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.		
I	The Multidisciplinary Nature of Environmental	Definition, scope and importance. Need for public awareness. Role of information technology in environment and human health. Human population and the	5	CO1



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	Studies	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.	5	
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	
III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of	5	CO3



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		the following ecosystem: - Forest ecosystem - Grassland ecosystem - Desert ecosystem - Aquatic ecosystem (ponds, streams, lakes, rivers, Oceans, estuaries). Case study on various ecosystems in India.		
		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	5	
V	Environmental Pollution Definition	Causes of Pollution , effects and control measures of: - Air pollution - Water pollution - Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	5	CO5



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		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	
Total			30	

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 Edition, PHI Learning, Publication Year: 2016
3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann 1. Springer 2008

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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)



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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	
12812310	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	IAT-1+IAT-2				
12812310	IDEA LAB - 3(Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

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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.



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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

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.



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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
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



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Semester-IV

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Theme: CrisisNet: Rapid Disaster Response & Aid Coordination

Aligned with UNSDG : SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 16 (Peace, Justice, and Strong Institutions)

Keywords: Natural disasters, emergency response teams, resource allocation, rescue, Relief materials, Disaster warnings.

The theme "CrisisNet: Rapid Disaster Response & Aid Coordination" is a critical framework for leveraging technology and organized efforts to mitigate the devastating impacts of various crises, from natural disasters to other large-scale emergencies. It's about creating a robust, interconnected system that ensures swift, efficient, and equitable support to affected populations, thereby strengthening community resilience and stability.

It aligns profoundly with UN Sustainable Development Goals (SDGs) SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 16 (Peace, Justice, and Strong Institutions), particularly in the context of building resilient and peaceful communities.

Alignment with UNSDG 11: Sustainable Cities and Communities

SDG 11 aims to "make cities and human settlements inclusive, safe, resilient and sustainable." "CrisisNet" directly contributes to this by:

- **Enhancing Urban and Rural Resilience:** Disasters (both natural and man-made) can cripple communities. CrisisNet's focus on rapid response and aid coordination means that cities and communities, whether urban centers like Mumbai or remote rural villages in Maharashtra, can better withstand and recover from shocks. By facilitating quick assessment of damage, efficient deployment of resources, and effective communication, it reduces the long-term impact of disasters on infrastructure, livelihoods, and social fabric.
- **Protecting Vulnerable Populations:** Disasters disproportionately affect the most vulnerable segments of society. CrisisNet, through its efficient coordination mechanisms, ensures that aid reaches those who need it most, including the poor, elderly, disabled, and women and children, thereby contributing to inclusive settlements where no one is left behind in times of crisis.
- **Improving Disaster Risk Reduction and Management:** A rapid and coordinated response system is a cornerstone of effective disaster risk reduction. CrisisNet can integrate early warning systems, facilitate the dissemination of crucial information, and support the evacuation and sheltering of affected populations, thereby minimizing casualties and property damage and making communities safer.

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- **Strengthening Community Infrastructure and Services:** Post-disaster recovery relies on effective aid. By streamlining aid coordination, CrisisNet helps in the swift restoration of essential services (water, sanitation, electricity, healthcare) and the rebuilding of resilient infrastructure, ensuring that communities can bounce back quickly and sustainably.

Alignment with UNSDG 13: Climate Action

SDG 13 calls for "taking urgent action to combat climate change and its impacts." "CrisisNet" plays a crucial role here because:

- **Addressing Climate Change-Induced Disasters:** Climate change is increasing the frequency and intensity of extreme weather events such as floods, droughts, heatwaves, and cyclones, which are common in regions like Maharashtra. CrisisNet provides the necessary framework for responding effectively to these climate-induced disasters, mitigating their immediate human and economic toll.
- **Facilitating Adaptation and Resilience Building:** While primarily a response mechanism, the data and insights gathered through CrisisNet's operations can inform long-term climate adaptation strategies. Understanding patterns of damage, aid requirements, and community vulnerabilities helps in planning resilient infrastructure and developing early warning systems tailored to climate-related risks, thereby enhancing overall adaptive capacity.
- **Minimizing Loss and Damage:** Rapid and effective aid coordination reduces the "loss and damage" caused by climate-related events. By ensuring timely medical attention, food, shelter, and psychological support, CrisisNet directly lessens the human suffering and economic disruption that climate change inflicts on communities.
- **Promoting Data-Driven Climate Response:** CrisisNet, as a technology-driven system, can collect real-time data on disaster impacts. This data is invaluable for climate scientists and policymakers to understand the localized effects of climate change, refine climate models, and develop more targeted and effective climate action plans.

Alignment with UNSDG 16: Peace, Justice, and Strong Institutions

SDG 16 aims to "promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels." "CrisisNet" contributes significantly by:

- **Building Effective and Accountable Institutions:** CrisisNet is fundamentally about creating a more organized, transparent, and efficient system for disaster response. This requires strong institutional frameworks, clear lines of authority, and accountability



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mechanisms for aid distribution and resource management, directly contributing to more effective and trustworthy governance during crises.

- **Enhancing Transparency and Reducing Corruption in Aid:** Disasters can sometimes create environments ripe for mismanagement or corruption. CrisisNet, through digital tracking, data transparency, and coordinated efforts, can significantly reduce opportunities for aid diversion, ensuring that resources reach their intended beneficiaries and fostering trust in the institutions managing the response.
- **Strengthening Partnerships and Collaboration:** Effective disaster response necessitates collaboration between government agencies, NGOs, civil society organizations, and local communities. CrisisNet acts as a platform for fostering these partnerships, improving communication, and ensuring that all stakeholders work cohesively towards common goals, leading to more inclusive and coordinated responses.
- **Ensuring Access to Information and Justice:** In the aftermath of a disaster, access to accurate information is crucial for survival and recovery. CrisisNet can provide a reliable channel for disseminating vital alerts, instructions, and information about aid availability. Furthermore, by ensuring proper aid distribution and addressing grievances related to the response, it indirectly supports the principle of justice for affected populations.
- **Promoting Peaceful Recovery:** Disasters can exacerbate existing social tensions or create new ones due to resource scarcity or perceived inequalities in aid distribution. A well-coordinated and transparent system like CrisisNet helps in equitably distributing resources and managing expectations, thus contributing to more peaceful and cohesive recovery processes.



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Problem Statements:

1. During natural disasters, emergency response teams (police, fire, ambulances) often lack a unified command center, leading to duplicated efforts and missed rescue operations.
 2. Lack of updated satellite or drone imagery prevents accurate assessment of disaster-hit zones, delaying resource allocation and rescue.
 3. Relief materials (food, water, medicine) are either oversupplied in some areas or don't reach the actual victims in time.
 4. Authorities release updates through different channels (Twitter, SMS, radio), but inconsistent messaging creates confusion among citizens.
 5. Disaster warnings issued only in English are not understood by a significant portion of the population, delaying their ability to comprehend the threat and respond effectively.
 6. Highway accidents often result in severe injuries where every minute counts. Ambulances frequently arrive late resulting in preventable fatalities. Rumors of exaggerated dangers spread quickly during crises causing unnecessary panic and misdirection of scarce resources.
- Post-disaster analysis reports are often buried in static documents, preventing planners from systematically using past insights to improve future preparedness.



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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	
12211401	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-1	IAT-2	IAT-1+IAT-2					
12211401	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In a second-year Computer Engineering course, understanding statistical tests and optimization techniques is fundamental for analyzing system performance and making informed design decisions. Large and small sample tests enable students to evaluate hypotheses about system behavior based on the size of data samples, such as testing network latency or processor reliability. The Chi-square and F-tests provide tools to examine categorical data relationships and compare variances, which are useful in validating error distributions and algorithm performance consistency. Optimization methods like the Simplex method and Duality assist in solving linear programming problems, such as optimizing CPU time allocation or resource management, while Nonlinear Kuhn-Tucker conditions extend these techniques to complex systems with nonlinear constraints, like balancing power and speed in embedded devices. Markov Chains offer a way to model stochastic processes where the next state depends only on the current state, helping to analyze network traffic and system states. Finally, Queuing Theory is essential for studying



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waiting lines in processors or network buffers, enabling engineers to optimize task scheduling and improve system throughput. Together, these concepts equip computer engineering students with practical tools to design, analyze, and optimize computing systems effectively.

Course Objectives:

1. To explain the principles of hypothesis testing for large and small samples to analyze computer system data.
2. To describe the use of Chi-square and F-tests for analyzing variance and independence in datasets.
3. To understand linear programming concepts to optimize resource allocation in computing tasks.
4. To explain the Kuhn-Tucker conditions to handle constraints in non-linear optimization problems.
5. To understand describe Markov chain models to represent stochastic processes in computing.
6. To understand queuing models to evaluate performance in computing environments.

Course Outcomes:

1. Students will be able to apply large and small sample tests to evaluate performance metrics like CPU utilization and network latency.
2. Students will be able to perform chi-square tests for validating error distributions in software and conduct f-tests to compare memory usage variances under different workloads.
3. Students will be able to solve optimization problems like scheduling or bandwidth allocation using the simplex method and interpret dual problems for constraint analysis.
4. Students will be able to formulate and analyze constrained non-linear optimization problems such as minimizing power consumption in embedded systems.
5. Students will be able to model system state transitions such as cache hits/misses or network routing behaviors using Markov chains.
6. Students will be able to analyze and optimize the performance of servers and network routers through queuing theory examples like M/M/1 and M/M/c queues.

Prerequisite:

1. Basic Probability Theory, Matrix Algebra.



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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.	10	
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).	10	
III	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables.	05	CO3
		Simplex method.		



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		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.	10	
IV	Nonlinear Programming Problems	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers	05	CO4
		NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions.		
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 4. Markov Processes State Space and Continuous time.	10	
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		



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		Queuing Networks		
		Self-learning Topics: 1. Priority Queues. 2. Queueing Disciplines. 3. Retrial Queues & Balking/Reneging 4. Queueing with Server Vacations	10	

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.
5. S. D. Sharma, "Operations Research", Kedarnath Ramnath Publishing, Meerut, 8th Edition, 2015.



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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/

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.
2. Class Tutorials on entire syllabus 10 marks.
3. Mini Project 10 marks.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12211402	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	IAT-1+IAT-2					
12211402	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

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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 (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. Comprehend the foundational principles of software development, including various software life cycle process models, agile methodologies, SCRUM, and other contemporary agile practices.
2. Apply methods for eliciting, specifying, visualizing, and analyzing software requirements, ensuring comprehensive understanding of stakeholder needs.
3. Design and implement software solutions utilizing core concepts and principles of software design, emphasizing user-centric approaches and principles of effective user interfaces.
4. Evaluate and select appropriate software testing strategies and tactics, implement quality assurance processes, and manage software configurations effectively.
5. Articulate the critical role of project management within the software development life cycle (SDLC) and assess the significance of Software Engineering in the overall Product Life Cycle (PLC).
6. Develop and optimize project schedules, construct network diagrams (AON, AOA), utilize CPM and PERT techniques, and mitigate project risks by organizing activities based on risk impact factors

Course Outcomes:

1. Categorize various software application domains and differentiate between diverse process models employed in software development (L2, L4)



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2. Formulate precise software specifications, classify distinct types of software requirements, and employ effective requirement gathering techniques. (L3, L4)
3. Translate requirements models into robust design models and demonstrate the application of sound software and user-interface design principles. (L3, L6)
4. Differentiate between Software Configuration Management (SCM) and Software Quality Assurance (SQA), evaluate various testing strategies and tactics, and compare their effectiveness. (L4, L5)
5. Justify the integral role of SDLC in Software Project Development and evaluate the paramount importance of Software Engineering within the overall Product Life Cycle.(L5)
6. Construct and optimize project schedules, design and develop network diagrams for diverse project types, and prioritize different project activities based on their risk impact factor. (L3, L5, L6)

Prerequisite:

DETAILED SYLLABUS:



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Nature of Software, Software Definition, Software Characteristics, Software Application Domains	-	-
I	Introduction to Software Engineering	Evolution and scope of software engineering. Software process models: Waterfall, Spiral, V-Model, Agile, DevOps. Characteristics of good software (reliability, maintainability, efficiency, etc.) Software engineering ethics and professional conduct. Overview of SDLC and software process activities.	8	CO1
		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, XP) 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) using IEEE standards. Feasibility analysis: Technical, economic, operational. Requirements validation and change management.	7	CO1, CO2



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		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
		Self-learning Topics: 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	8	CO5



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		of reviews, inspections, and audits in ensuring software quality		
		Self-learning Topics: Practice Black-box and White-box Testing Techniques. Study Cybersecurity in IoT-Enabled Supply Chains	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. Risk management and stakeholder communication strategies. Building a Project Charter and Work Breakdown Structure (WBS). Types of maintenance: Corrective, Adaptive, Preventive. Configuration and change management tools.	7	CO1, CO2, CO3, CO4, CO6
		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	



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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 and Supply Chain Traceability	12	



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		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		



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		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 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.



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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))



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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	
12211403	Microprocessor & Microcontroller	3	--	--	45	--	--	45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
12211403	Microprocessor & Microcontroller	20	20	40	60	2.5	--	--	100

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Rationale

Microprocessors form the backbone of computer engineering and embedded systems, enabling students to understand hardware-software integration. With applications in disaster response—such as early warning systems and emergency communication—this course, integrated with the **CrisisNet** theme, equips students to build rapid, resilient solutions for crisis management, supporting **SDG 11** and **SDG 13**.

Course Objectives:

- 1) Understand the evolution, architecture, and applications of microcomputer systems and Intel microprocessors.
- 2) Analyze the software architecture and memory organization of the 8086/88 microprocessors.
- 3) Apply knowledge of the instruction set and addressing modes to develop assembly language programs.
- 4) Design microprocessor-based systems using memory and I/O interfacing techniques.
- 5) Interface peripheral devices and controllers with microprocessors.
- 6) Understand the role and function of co-processors and advanced Intel microprocessors.

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Course Outcomes:

Students will be able to-

- 1) Describe microprocessor architecture and its relevance in emergency systems.
- 2) Develop optimized assembly code for time-critical and modular disaster response tasks.
- 3) Design memory and peripheral interfaces for real-time monitoring and control.
- 4) Interface and program peripheral controllers to manage distributed sensors and communication.
- 5) Create mini-projects simulating components of CrisisNet (e.g., emergency alert devices, field routers).
- 6) Apply embedded techniques to build hardware prototypes for disaster-prone areas.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Digital Electronics, Basic Computer Architecture		
I		• General microcomputer	8	CO1

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Introduction to Microprocessors and Microcomputers	architecture ● Evolution of Intel microprocessors (up to 8086/88) ● Stored program concept ● Applications of microcomputers. Real-world examples: Drones, emergency buttons, field terminals		
		Self-learning topics- ● Timeline and comparison of Intel processor generations (8086 to modern x86) ● Case studies on microprocessor use in real-time crisis systems (e.g., earthquake detectors)	8	CO1
II	8086/88 Software Architecture	● Memory segmentation, types of memory (dedicated, reserved, general use) ● Data types and memory organization	8	CO2

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		- Addressing modes for sensor data and controller commands - Instruction set design: emphasis on control transfer, string handling in signal processing		
		Self-learning topics- - Intel addressing mode animations/tutorials (Intel Developer docs) - Microprocessor behavior under low-power and emergency modes (e.g., sleep mode, reset handling)	8	CO2
III	Assembly Language Programming	- Programming process: Specification, design, coding, assembling, testing, debugging - Modularization of problems and use of procedures and macros - Arithmetic and logical programming	7	CO3

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		- Delay generation, use of data tables - Programming examples and case studies- Fire sensor polling, Alert broadcasting loop, Portable GPS data encoder		
		Self-learning topics- - Use of procedures and macros for sensor data parsing and alert message formatting - Exploration of open-source disaster alert code snippets in x86 assembly	7	CO3
IV	8086/88 Hardware Architecture	- Three-bus architecture - Clock and reset generation - Bus types and buffering techniques - Minimum and maximum mode operations. Design considerations for disaster-	8	CO4

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		prone environments		
		Self-learning topics- - PCB design basics and layout tools for microprocessor boards (e.g., KiCAD) - System clock synchronization in distributed sensor systems	8	CO4
V	Memory and I/O Interfacing	- Interfacing techniques: Memory and I/O module design - Parallel and serial I/O - Programmed I/O, interrupt-driven I/O (using 8279) - DMA-based data transfer (using 8237)	7	CO5
		Self-learning topics- - Animation-based learning of interrupt cycle vs polling - Serial vs parallel communication – pros & cons	7	CO5

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		in crisis response systems		
VI	Peripheral Controllers and Coprocessors	Programming and interfacing of: • 8237 (DMA for alerts) • 8251 (Serial communication for data modems) • 8255 (Sensor interface for water/flood levels) • 8259 (Interrupt management for event-driven response) • 8279 (Keypad/display in field nodes) • Introduction to 8087 (numeric processing for terrain data) • 8089 (I/O processor for aid distribution stations) • Conceptual overview of integrating 80186/80286 in scalable networks	7	CO6
		Self-learning topics-	7	CO6

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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		- Real-world interfacing of water level sensors using 8255/ADC - Comparison of serial protocols (RS232, I2C, SPI) for field devices		

Text Books:

1. The 8086/8088 Family: Design, Programming and Interfacing, John Uffenbeck, PHI Learning, 2nd Edition, 2002
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Walter A. Triebel and Avtar Singh, PHI Learning, 4th Edition, 2002
3. Microprocessor and Interfacing: Programming and Hardware, Douglas V. Hall, McGraw-Hill, Revised 2nd Edition, 2005

References:

1. Advanced Microprocessors and Peripherals, A.K. Ray and K.M. Bhurchandi, McGraw-Hill, 3rd Edition, 2012
2. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford University Press, 1st Edition, 2010

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3. Assembly Language Programming and Organization of the IBM PC, Ytha Yu and Charles Marut, McGraw-Hill, 2nd Edition, 1992

4. Modern Digital Electronics, R. P. Jain, McGraw-Hill, Fourth Edition, 2010

Online References:

Sr. No.	Website Name
1.	NPTEL – Microprocessors and Microcontrollers, Fundamentals of Microprocessors
2.	Intel Developer Zone
3.	CrisisNet for dataset insights (for project simulation)
4.	YouTube Channels: Neso Academy, Gate Smashers (Assembly & Interfacing)

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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	
12212404	Integrated Lab 2	--	--	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	IAT-1+ IAT-2				
12212404	Integrated Lab 2	--	--	--	--	25	25	50

Lab Objectives:

- 1) Provide hands-on experience with 8086 assembly language programming.
- 2) Enable design and implementation of field-ready embedded systems for CrisisNet use cases.



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- 3) Encourage innovation through project-based learning for social impact (SDG 11 & 13)
- 4) To develop foundational skills in Linux system administration, including user management, file operations, and process handling.
- 5) To introduce core DevOps principles and practices including DevSecOps, SRE, and NoOps
- 6) To equip students with practical skills in version control using Git and GitHub/GitLab, shell scripting for automation, configuration management, containerization.

Lab Outcomes:

Students will be able to-

- 1) Write and test modular assembly programs for real-time applications.
- 2) Interface and control peripherals like switches, sensors, and displays.
- 3) Simulate and implement real-time alerting and communication routines.
- 4) Use microprocessors to prototype miniaturized disaster-response tools.
- 5) Apply embedded techniques to CrisisNet-relevant project solutions.
- 6) Document, debug, and present a functional embedded prototype.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Write, assemble, and verify basic 8086 assembly language programs for arithmetic and logical operations using an emulator/simulator.	2
02	Generate accurate time delays using loop instructions in 8086 and verify the timing behavior on simulation tools.	2
03	Simulate and verify the functioning of 8279 keyboard/display interface for visual output in alert systems.	2

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04	Interface 8255 with LEDs and switches to simulate and verify parallel I/O operations used in disaster signal panels.	2
05	Simulate and verify ADC interfacing to read analog sensor values such as temperature or flood levels using a digital circuit simulator.	2
06	Simulate and test interrupt-driven input handling using 8259 to prioritize sensor events in a disaster response context.	2
07	Configure and simulate DMA-based data transfer using 8237 and verify efficiency in handling bulk alert data.	2
08	Design and implement a mini-project simulating a CrisisNet component such as a flood monitoring system or emergency alert terminal using microprocessor hardware or simulation tools.	2
09	Interface stepper motor or buzzer control logic (simulated) to 8255 to model movement or acoustic alerts in hazard-prone zones.	2
10	To develop foundational skills in Linux system administration, including user management, file operations, and process handling.	2
11	To introduce core DevOps principles and practices including DevSecOps, SRE, and NoOps.	2
12	To enable effective use of Git and GitHub/GitLab for version control and collaborative software development	2
13	To equip students with the ability to write and use shell scripts for automating system and administrative tasks	2
14	To train students in configuration management, containerization, and building CI/CD pipelines using tools like Ansible, Docker, and Jenkins.	2

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15	To provide knowledge of secure DevOps practices, monitoring systems, and logging tools aligned with modern observability and SRE frameworks	2

Sr No	List of Assignments / Tutorials	Hrs
1	Assignment- 1: Assembly Programming for Disaster Alert Logic- Write and simulate an 8086 assembly program to detect a critical threshold and trigger an alert. Tools: Emulator like Emu8086 or GNUSim8086 Deliverable: Program listing, screenshot of output, explanation of logic used.	2
2	Assignment- 2: Design I/O Interface for Emergency Button Panel Using 8255- Simulate and design an emergency input/output control panel using the 8255 PPI. Tools: Proteus or any digital simulator Deliverable: Circuit diagram, 8255 control word, explanation of each port's function, screenshots of simulation.	2

Text Books:

1. The 8086/8088 Family: Design, Programming and Interfacing, John Uffenbeck, PHI Learning, 2nd Edition, 2002
2. The 8088 and 8086 Microprocessors: Programming, Interfacing, Software, Hardware and Applications, Walter A. Triebel and Avtar Singh, PHI Learning, 4th Edition, 2002
3. Microprocessor and Interfacing: Programming and Hardware, Douglas V. Hall, McGraw-Hill, Revised 2nd Edition, 2005
4. The Linux DevOps Handbook by Damian Wojsław & Grzegorz Adamowic.
5. How Linux Works: What Every Superuser Should Know (3rd Edition) by Brian Ward



References:

1. Advanced Microprocessors and Peripherals, A.K. Ray and K.M. Bhurchandi, McGraw-Hill, 3rd Edition, 2012
2. Microprocessors and Microcontrollers, N. Senthil Kumar, M. Saravanan, S. Jeevanathan, Oxford University Press, 1st Edition, 2010
3. Assembly Language Programming and Organization of the IBM PC, Ytha Yu and Charles Marut, McGraw-Hill, 2nd Edition, 1992
4. Modern Digital Electronics, R. P. Jain, McGraw-Hill, Fourth Edition, 2010.
5. The Linux Documentation Project. (n.d.). Linux System Administrator's Guide. Retrieved from <https://www.tldp.org/LDP/sag/html/index.html>
6. Medium. (2021). DevOps: Complete CI/CD Pipeline Setup. Retrieved from <https://medium.com/@abhishekjain.wisdom/devops-complete-ci-cd-pipeline-setup-d64b410f3240>

Online References:

Sr. No.	Website Name
1.	NPTEL – Microprocessors and Microcontrollers, Fundamentals of Microprocessors
2.	Intel Developer Zone
3.	CrisisNet for dataset insights (for project simulation)
4.	YouTube Channels: Neso Academy, Gate Smashers (Assembly & Interfacing)
5.	Linux From Scratch (linuxfromscratch.org)
6.	Awesome DevOps Books on GitHub



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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.



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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	
12212405	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	IAT-1+ IAT-2				
12212405	IDEA LAB - 4(Innovation Design Engineering and Apply)	--	--	--	--	50	50	100

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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



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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



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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

Aspect	Implementation Strategy
Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.



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Aspect	Implementation Strategy
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:



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- 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

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Criteria	Month 1 (5)	Month 2 (10)	Month 3 (10)
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



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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



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		L	T	P	L	T	P	SL	Notional Learning Hour	
12412406	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	IAT-1+IAT-2					
12412406	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.

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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)
- 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

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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
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

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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
2.	https://spring.io – Official Spring Boot Docs
3.	https://reactjs.org – React Documentation
4.	https://getbootstrap.com – Bootstrap Docs

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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.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Teaching Scheme (Contact Hours Per Semester)					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
9951149WW	Open Elective	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	IAT-1+IA T-2					
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)

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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	IAT-1+IAT-2					
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.
4. Apply ideation techniques to generate creative solutions.

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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:	4	



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		Design thinking case studies from various domains. Link: https://www.design-thinking-association.org/explore-design-thinking-topics/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,	6	CO4



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		Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind mapping		
		Self-learning Topics: How To Run an Effective Ideation Workshop: A Step-By-Step Guide Link: https://uxplanet.org/how-to-run-an-effective-ideation-workshop-a-step-by-step-guide-d520e41b1b96	6	
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	
Total			30	

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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, 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

Assessment:

Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

Question paper format



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- Question Paper will comprise of a total of **six questions each carrying 15 marks**
Q.1 will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Four questions** need to be answered



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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	IAT-1+IAT-2					
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:

1. To introduce students to entrepreneurship and its socio-economic relevance.

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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		
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/default-	5	



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		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).	5	CO3
		Self-learning Topics: Successful business pitching. Case Study: Shark Tank pitch breakdown.	5	
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.	5	CO4
		Self-learning Topics: Case Study: WIPO Patent Search Exercise	5	

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V	Business Model Development	Types of business models, Value proposition, Customer segments, Customer relationships, Channels, Key partners, Key activities, Key resources, Prototyping and MVP.	6	CO5
		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	6	
VI	Digital Business Management	Digital Business models (Subscription, Freemium <i>etc</i>), Digital marketing: Search Engine Optimization (SEO), Search Engine Marketing (SEM), Social media and influencer marketing, Disruption and innovation in digital business.	5	CO6
		Self-learning Topics: Case study: Airbnb https://www.prismetric.com/airbnb-business-m	5	
Total			30	

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

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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, 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.prismetric.com/airbnb-business-model/
7.	BMC Tool https://www.strategyzer.com/canvas/business-model-canvas



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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).



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T.E Syllabus

Semester-V



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC501	Theoretical Computer Science	3	-	1	3	-	1	4

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duration (in Hrs)			
		IAT- 1	IAT - 2	IAT- 1+IAT- 2					
CMC501	Theoretical Computer Science	20	20	40	60	2.5	25	--	125

Course Objectives:

1. Describe the basic components and classifications of formal grammars and languages.
2. Explain the theoretical concepts behind deterministic and non-deterministic finite automata.
3. Design finite automata for specific language recognition problems.
4. Construct pushdown automata for context-free languages.
5. Compare different types of Turing machines and explain their real-world applications.
6. Interpret and evaluate the concept of undecidability in computational problems.

Course Outcomes:

1. Define and describe fundamental concepts of formal grammars, languages, and

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- automata.
2. Explain the working principles of deterministic and non-deterministic finite automata and pushdown automata.
 3. Construct finite automata and pushdown automata for given language specifications.
 4. Differentiate between regular, context-free, and recursively enumerable languages using automata theory.
 5. Evaluate the computational power and limitations of Turing machines in solving problems.
 6. Design Turing machines and formal models to solve real-world computational problems, and justify their correctness.

Prerequisite: Discrete Structures

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Basic Concepts and Finite Automata	Importance of TCS, Alphabets, Strings, Languages, Closure properties, Finite Automata (FA) and Finite State machine (FSM). Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, Equivalence between NFA with and without ϵ- transitions, NFA to DFA Conversion, Minimization of DFA, FSM with output: Moore and Mealy machines, Applications and limitations of FA.	09	CO1



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II	Regular Expressions and Languages	Regular Expression (RE), Equivalence of RE and FA, Arden's Theorem, RE Applications Regular Language (RL), Closure properties of RLs, Decision properties of RLs, Pumping lemma for RLs.	07	CO2
III	Grammars & Context Free Grammars (CFG)	Grammars and Chomsky hierarchy Regular Grammar (RG), Equivalence of Left and Right linear grammar, Equivalence of RG and FA. Definition, Sentential forms, Leftmost and Rightmost derivations, Parse tree, Ambiguity, Simplification and Applications, Normal Forms: Chomsky Normal Forms (CNF) and Greibach Normal Forms (GNF), Context Free language (CFL) - Pumping lemma, Closure properties.	08	CO3
IV	Pushdown Automata (PDA)	Definition, Language of PDA, PDA as generator, decider and acceptor of CFG, Deterministic PDA, Non-Deterministic PDA, Application of PDA.	04	CO4
V	Turing Machine (TM)	Definition, Design of TM as generator, decider and acceptor, Variants of TM: Multitrack, Multitape, Universal TM, Applications, Power and Limitations of TMs.	09	CO5

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VI	Undecidability	Decidability and Undecidability, Recursive and Recursively Enumerable Languages, Halting Problem, Rice's Theorem, Post Correspondence Problem.	02	CO6

Text Books:

1. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, “**Introduction to Automata Theory, Languages and Computation**”, 3rd Edition, Pearson Education, 2008.
2. Michael Sipser, “**Theory of Computation**”, 3rd Edition, Cengage learning. 2013.
3. Vivek Kulkarni, “**Theory of Computation**”, Illustrated Edition, Oxford University Press, (12 April 2013) India.

References:

1. J. C. Martin, “**Introduction to Languages and the Theory of Computation**”, 4th Edition, Tata McGraw Hill Publication, 2013.
2. Kavi Mahesh, “**Theory of Computation: A Problem-Solving Approach**”, Kindle Edition, Wiley-India, 2011.

Online References:

Sr. No.	Website Name
1.	www.jflap.org
2.	https://nptel.ac.in/courses/106/104/106104028/
3.	https://nptel.ac.in/courses/106/104/106104148/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC502	Software Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -1	IAT- 2	IAT- 1+IAT -2					
CMC502	Software Engineering	20	20	40	60	2.5		-	100

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Course Objectives:

1. To provide an overview of software engineering concepts, practices, and the software development process.
2. To introduce various software development life cycle (SDLC) models and methodologies.
3. To apply requirement analysis techniques for understanding and documenting software needs.
4. To design software systems using appropriate tools, models, and documentation standards.
5. To perform testing, debugging, and validation of software applications
6. To demonstrate complete software projects and evaluate their effectiveness in solving real-world problems

Course Outcomes:

1. Identify and analyse software requirements and evaluate appropriate software process models. Explain the working principles of deterministic and non-deterministic finite automata and pushdown automata.
2. Plan and schedule software development activities and track project progress using standard project management tools.
3. Design system architecture and software components using structured and object-oriented approaches Evaluate the computational power and limitations of Turing machines in solving problems.
4. Develop and perform software testing strategies for defect identification and validation.
5. Identify and manage risks, and apply change management techniques to ensure project quality.
6. Evaluate and demonstrate completed software projects based on performance, usability, and quality metrics.

Prerequisite: Object Oriented Programming with Java, Python Programming



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction To Software Engineering and Process Models	Software Engineering-process framework, the Capability Maturity Model (CMM), Advanced Trends in Software Engineering 1.2 Prescriptive Process Models: The Waterfall, Incremental Process Models, Evolutionary Process Models: RAD & Spiral 1.3 Agile process model: Extreme Programming (XP), Scrum, Kanban	07	CO1
II	Software Requirements Analysis and Modeling	Requirement Engineering, Requirement Modeling, Data flow diagram, Scenario based model, Software Requirement Specification document format (IEEE)	04	CO2
III	Software Estimation Metrics	Software Metrics, Software Project Estimation (LOC, FP, COCOMO II) Project Scheduling & Tracking	07	CO3
IV	Software Design	Design Principles & Concepts. Effective Modular Design, Cohesion and Coupling, Architectural design	07	CO4
V	Software Testing	Unit testing, Integration testing, Validation testing, System testing. Testing Techniques, white-box testing: Basis path, Control structure testing black-box testing: Graph based, Equivalence, Boundary Value. Types of Software	07	CO5

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		Maintenance, Re-Engineering, Reverse Engineering		
VI	Software Configuration Management, Quality Assurance and Maintenance	Risk Analysis & Management: Risk Mitigation, Monitoring and Management Plan (RMMM). Quality Concepts and Software Quality assurance Metrics, Formal Technical Reviews, Software Reliability. The Software Configuration Management (SCM), Version Control and Change Control	07	CO6

Text Books:

1. Roger Pressman, **“Software Engineering: A Practitioner ‘s Approach”**, 9th edition, McGraw-Hill Publications, 2019
2. Ian Sommerville, **“Software Engineering”**, 9th edition, Pearson Education, 2011
3. Ali Behfroz and Fredeick J. Hudson, **"Software Engineering Fundamentals"**, Oxford University Press, 1997
4. Grady Booch, James Rumbaugh, Ivar Jacobson, **“The unified modeling language user guide”**, 2nd edition, Pearson Education, 2005

References:

1. Pankaj Jalote, **"An integrated approach to Software Engineering"**, 3rd edition, Springer, 2005
2. Rajib Mall, **"Fundamentals of Software Engineering"**, 5th edition, Prentice Hall India, 2014
3. Jibitesh Mishra and Ashok Mohanty, **“Software Engineering”**, Pearson , 2011
4. Ugrasen Suman, **“Software Engineering – Concepts and Practices”**, Cengage Learning, 2013



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5 Waman S Jawadekar, “**Software Engineering principles and practice**”, McGraw Hill Education, 2004

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/105/106105182/
2.	https://onlinecourses.nptel.ac.in/noc19_cs69/preview
3.	https://www.mooc-list.com/course/software-engineering-introduction-edx



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC503	Computer Network	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duration (in Hrs)			
		IAT- 1	IAT - 2	IAT- 1+IAT- 2					
CMC503	Computer Network	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the basic concepts and fundamental principles of data communication and computer networks.
2. To provide a comprehensive understanding of the structure and functions of the OSI reference model and its individual layers.
3. To examine the design challenges and operational aspects of the TCP/IP protocol suite.
4. To study and analyze different routing algorithms along with their comparative advantages and limitations.
5. To understand the functioning and significance of various transport layer protocols in ensuring reliable communication.
6. To explore application layer protocols and their role in enabling end-user network services.

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Course Outcomes:

1. Demonstrate the fundamental concepts of data communication at the physical layer and compare the ISO-OSI model with the TCP/IP model.
2. Identify and explain key design issues and protocols at the data link layer.
3. Apply IP addressing techniques to design efficient network architectures using subnetting and supernetting.
4. Analyze transport layer functionalities, protocols, and evaluate various congestion control algorithms.
5. Explore and illustrate the role of common application layer protocols and services in real-world communication.
6. Integrate the concepts across all network layers to design and troubleshoot end-to-end network communication solutions.

Prerequisite: Basic Programming Skills, Computer Organization & Architecture, Operating Systems

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Networking	Introduction to computer network, network application, network software and hardware components (Interconnection networking devices), Network topology, protocol hierarchies, design issues for the layers, connection oriented and connectionless services. Reference models: Layer details of OSI, TCP/IP models. Communication between layers.	04	CO1
II	Physical Layer	Introduction to Communication Electromagnetic Spectrum. Guided Transmission Media: Twisted pair, Coaxial, Fiber optics.	03	CO2



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III	Data Link Layer & Medium Access Control sublayer	DLL Design Issues (Services, Framing, Error Control, Flow Control), Error Detection and Correction (Hamming Code, CRC, Checksum), Elementary Data Link protocols, Stop and Wait, Sliding Window (Go Back N, Selective Repeat). Medium Access Control Sublayer Channel Allocation problem, Multiple access Protocol (Aloha, Carrier Sense Multiple Access (CSMA/CD))	08	CO3
IV	Network layer	Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. IPv4 Addressing (classfull and classless), Subnetting, Supernetting design problems, IPv4 Protocol, Network Address Translation (NAT), IPv6. Routing algorithms: Shortest Path (Dijkstra's), Link state routing, Distance Vector Routing. Protocols - ARP, RARP, ICMP, IGMP. Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters, Token & Leaky bucket algorithms	12	CO4
V	Transport Layer	The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers. TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	06	CO5

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VI	Application Layer	DNS: Name Space, Resource Record and Types of Name Server. HTTP, SMTP, Telnet, FTP, DHCP	06	CO6

Text Books:

1. A.S. Tanenbaum, **Computer Networks**, 4th edition Pearson Education
2. B.A. Forouzan, **Data Communications and Networking**, 5th edition, TMH
3. James F. Kurose, Keith W. Ross, **Computer Networking, A Top-Down Approach Featuring the Internet**, 6th edition, Addison Wesley

References:

1. S.Keshav, **An Engineering Approach To Computer Networking**, Pearson
2. Natalia Olifer & Victor Olifer, **Computer Networks: Principles, Technologies & Protocols for Network Design**, Wiley India, 2011.
3. Larry L. Peterson, Bruce S. Davie, **Computer Networks: A Systems Approach**, Second Edition, The Morgan Kaufmann Series in Networking

Online References:

Sr. No.	Website Name
1	https://www.netacad.com/courses/networking/networking-essentials
2	https://www.coursera.org/learn/computer-networking
3	https://nptel.ac.in/courses/106/105/106105081
4	https://www.edx.org/course/introduction-to-networking



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC504	Data Warehousing and Mining	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT- 2					
CMC504	Data Warehousing and Mining	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To identify the significance and applications of Data Warehousing and Data Mining in various domains.
2. To understand the architecture, components, and operations involved in building a data warehouse.
3. To analyze large datasets and apply appropriate models and algorithms for mining useful patterns.
4. To explore different types of data mining techniques such as classification, clustering, and association rule mining.
5. To study the concepts and techniques involved in Web Data Mining and their real-world

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- relevance.
6. To develop interest and understanding in current trends, tools, and research areas in data mining.

Course Outcomes:

1. Understand the fundamentals of data warehousing and apply dimensional modeling techniques to design data warehouses along with performing OLAP operations.
2. Explain data mining principles and perform data preprocessing and visualization for analytical readiness.
3. Identify and apply suitable data mining algorithms to address specific real-world problems.
4. Compare and evaluate different data mining techniques such as classification, prediction, clustering, and association rule mining.
5. Describe and interpret the structure and behavior of complex information and social networks in the context of web mining.
6. Design and implement data-driven solutions by integrating multiple data mining techniques for domain-specific applications.

Prerequisite: Database Concepts

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Data Warehousing Fundamentals	Introduction to Data Warehouse, Data warehouse architecture, Data warehouse versus Data Marts, E-R Modeling versus Dimensional Modeling, Information Package Diagram, Data Warehouse Schemas; Star Schema, Snowflake Schema, Factless Fact Table, Fact Constellation Schema. Update to the dimension tables. Major steps in ETL process, OLTP versus OLAP,	08	CO1



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		OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot.		
II	Introduction to Data Mining, Data Exploration and Data Pre-processing	Data Mining Task Primitives, Architecture, KDD process, Issues in Data Mining, Applications of Data Mining, Data Exploration: Types of Attributes, Statistical Description of Data, Data Visualization, Data Preprocessing: Descriptive data summarization, Cleaning, Integration & transformation, Data reduction, Data Discretization and Concept hierarchy generation.	08	CO2
III	Classification	Basic Concepts, Decision Tree Induction, Naïve Bayesian Classification, Accuracy and Error measures, Evaluating the Accuracy of a Classifier: Holdout & Random Subsampling, Cross Validation, Bootstrap.	06	CO3
IV	Clustering	Types of data in Cluster analysis, Partitioning Methods (k-Means, k-Medoids), Hierarchical Methods (Agglomerative, Divisive).	06	CO4
V	Mining frequent patterns and associations	Market Basket Analysis, Frequent Item sets, Closed Item sets, and Association Rule, Frequent Pattern Mining, Apriori Algorithm, Association Rule Generation, Improving the Efficiency of Apriori, Mining Frequent Itemsets without candidate 6 generation, Introduction to Mining Multilevel Association Rules and Mining Multidimensional Association Rules.	06	CO5

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VI	Web Mining	Introduction, Web Content Mining: Crawlers, Harvest System, Virtual Web View, Personalization, Web Structure Mining: Page Rank, Clever, Web Usage Mining.	05	CO6

Text Books:

1. Paulraj Ponniah, **“Data Warehousing: Fundamentals for IT Professionals”**, Wiley India.
2. Han, Kamber, **“Data Mining Concepts and Techniques”**, Morgan Kaufmann 2nd edition.
3. M.H. Dunham, **“Data Mining Introductory and Advanced Topics”**, Pearson Education.

References:

1. Reema Theraja, **“Data warehousing”**, Oxford University Press 2009.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, **“Introduction to Data Mining”**, Pearson Publisher 2nd edition.
3. Ian H. Witten, Eibe Frank and Mark A. Hall, **“Data Mining”**, Morgan Kaufmann 3rd edition.

Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc20_cs12/preview
2	https://www.coursera.org/specializations/data-mining

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC551	Probabilistic Graphical Models	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duration (in Hrs)			
		IA T-1	IAT - 2	IAT- 1+IAT- 2					
CMC551	Probabilistic Graphical Models	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide a comprehensive introduction to the fundamental concepts, structures, and components of probabilistic graphical models.
2. To explain the representation of uncertainty and dependencies using Bayesian Networks and Markov Random Fields.
3. To explore inference techniques used in probabilistic graphical models, including exact and approximate inference.
4. To introduce the learning mechanisms for both model structure and parameters using observed data.
5. To highlight the practical challenges and trade-offs encountered when applying graphical models in real-world scenarios.
6. To develop the skills required to design, implement, and apply probabilistic graphical

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models to solve complex real-world problems across various domains.

Course Outcomes:

1. Understand the fundamental concepts of probabilistic graphical models and their role in modeling uncertainty.
2. Illustrate the structure and components of graphical models such as Bayesian Networks and Markov Networks.
3. Apply inference algorithms to derive meaningful insights from probabilistic graphical models.
4. Analyze learning methods for parameters and structures in probabilistic models using real-world data.
5. Evaluate the performance and limitations of graphical models when used for decision-making and predictions.
6. Design and implement solutions to complex problems using probabilistic graphical models in real-life applications.

Prerequisite: Engineering Mathematics, Discrete Structure

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Probabilistic Graphical Modeling	Introduction to Probability Theory: Probability Theory, Basic Concepts in Probability, Random Variables and Joint Distribution, Independence and Conditional Independence, Continuous Spaces, Expectation and Variances. Introduction to Graphs: Nodes and Edges, Subgraphs, Paths and Trails, Cycles and Loops. Introduction to Probabilistic Graph Models: Bayesian Network, Markov Model,	05	CO1



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		Hidden Markov Model. Applications of PGM		
II	Bayesian Network Model and Inference	Directed Graph Model: Bayesian Network-Exploiting Independence Properties, Naive Bayes Model, Bayesian Network Model, Reasoning Patterns, Basic Independencies in Bayesian Networks, Bayesian Network Semantics, Graphs and Distributions. Modelling: Picking variables, Picking Structure, Picking Probabilities, D Separation. Local Probabilistic Models: Tabular CPDs, Deterministic CPDs, Context Specific CPDs, Generalized Linear Models. Exact inference variable elimination: Analysis of Complexity, Variable Elimination, Conditioning, Inference with Structured CPDs.	10	CO2
III	Markov Network Model and Inference	Undirected Graph Model: Markov Model-Markov Network, Parameterization of Markov Network, Gibb's distribution, Reduced Markov Network, Markov Network Independencies, From Distributions to Graphs, Fine Grained Parameterization, Over Parameterization. Exact inference variable elimination: Graph Theoretic Analysis for Variable Elimination, Conditioning.	08	CO3



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IV	Hidden Markov Model and Inference	Template Based Graph Model: HMM- Temporal Models, Template Variables and Template Factors, Directed Probabilistic Models, Undirected Representation, Structural Uncertainty.	06	CO4
V	Learning and Taking Actions and Decisions	Learning Graphical Models: Goals of Learning, Density Estimation, Specific Prediction Tasks, Knowledge Discovery. Learning as Optimization: Empirical Risk, over fitting, Generalization, Evaluating Generalization Performance, selecting a Learning Procedure, Goodness of fit, Learning Tasks. Parameter Estimation: Maximum Likelihood Estimation, MLE for Bayesian Networks. Causality: Conditioning and Intervention, Correlation and Causation, Causal Models, Structural Causal Identifiability, Mechanisms and Response Variables, Learning Causal Models. Utilities and Decisions: Maximizing Expected Utility, Utility Curves, Utility Elicitation. Structured Decision Problems: Decision Tree	06	CO5
VI	Applications	Application of Bayesian Networks: Classification, Forecasting, Decision Making. Application of Markov Models: Cost Effectiveness Analysis, Relational Markov Model and its Applications, Application in Portfolio Optimization. Application of HMM: Speech Recognition, Part of Speech Tagging, Bioinformatics.	04	CO6

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Text Books:

1. Daphne Koller and Nir Friedman, "**Probabilistic Graphical Models: Principles and Techniques**", Cambridge, MA: The MIT Press, 2009 (ISBN 978-0-262-0139 2).
2. David Barber, "**Bayesian Reasoning and Machine Learning**", Cambridge University Press, 1st edition, 2011..

References:

1. Finn Jensen and Thomas Nielsen, "**Bayesian Networks and Decision Graphs (Information Science and Statistics)**", 2nd Edition, Springer, 2007.
2. Kevin P. Murphy, "**Machine Learning: A Probabilistic Perspective**", MIT Press, 2012.
3. Martin Wainwright and Michael Jordan, M., "**Graphical Models, Exponential Families, and Variational Inference**", 2008.

Online References:

Sr. No.	Website Name
1	https://www.coursera.org/specializations/probabilistic-graphical-models
2	https://www.mooc-list.com/tags/probabilistic-graphical-models
3	https://www.utas.edu.au/_data/assets/pdf_file/0009/588474/TR_14_BNs_a_resource_guide.pdf
4	https://www.upgrad.com/blog/bayesian-networks/
5	https://link.springer.com/chapter/10.1007/978-3-319-43742-2_24

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC552	Internet Programming	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT - 2	IAT- 1+IAT- 2					
CMC552	Internet Programming	20	20	40	60	2.5	--	--	100

Course Objectives:

1. Understanding the fundamental concepts and architecture of Internet Programming.
2. Exploring client-side and server-side technologies used in modern web development.
3. Developing knowledge for designing and building dynamic and interactive websites.
4. Familiarization with tools and techniques for building responsive web applications.
5. Introduction to web extensions and commonly used web services and standards.
6. Gaining insights into the characteristics and development of Rich Internet Applications (RIA) using React JS.

Course Outcomes:

1. Implement interactive web pages using HTML and CSS.

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2. Design responsive websites using JavaScript and ensure seamless integration with a database using JDBC.
3. Develop Rich Internet Applications (RIA) using Ajax techniques for enhanced user experience.
4. Differentiate various web extensions based on their functionalities and use cases.
5. Construct full-stack web applications incorporating both client-side and server-side logic.
6. Evaluate the effectiveness of React JS in building scalable and maintainable web applications.

Prerequisite: Data Structures, Programming Languages- JAVA, Python

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Web Technology	Web Essentials: Clients, Servers and Communication, The Internet, Basic Internet protocols, World wide web, HTTP Request Message, HTTP Response Message, Web Clients, Web Servers HTML5 – fundamental syntax and semantics, Tables, Lists, Image, HTML5 control elements, Semantic elements, Drag and Drop, Audio – Video controls CSS3 – Inline, embedded and external style sheets – Rule cascading, Inheritance, Backgrounds, Border Images, Colors, Shadows, Text,	10	CO1



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		Transformations, Transitions, Animation, Basics of Bootstrap.		
II	Front End Development	Java Script: An introduction to JavaScript–JavaScript DOM Model Date and Objects-Regular Expressions- Exception Handling Validation-Built-in objects-Event Handling, DHTML with JavaScript-JSON introduction – Syntax – Function Files – Http Request – SQL.	07	CO2
III	Back End Development	Servlets: Java Servlet Architecture, Servlet Life Cycle, Form GET and POST actions, Session Handling, Understanding Cookies, Installing and Configuring Apache Tomcat Web Server, Database Connectivity: JDBC perspectives, JDBC program example JSP: Understanding Java Server Pages, JSP Standard Tag Library (JSTL), Creating HTML forms by embedding JSP code.	07	CO3
IV	Rich Internet Application (RIA)	Characteristics of RIA, Introduction to AJAX: AJAX design basics, AJAX vs Traditional Approach, Rich User Interface using Ajax, jQuery framework with AJAX.	04	CO4
V	Web Extension: PHP and XML	XML –DTD (Document Type Definition), XML Schema, Document Object Model, Presenting XML, Using XML Parsers: DOM and SAX, XSL-eXtensible Stylesheet Language	06	CO5

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		Introduction to PHP- Data types, control structures, built in functions, building web applications using PHP- tracking users, PHP and MySQL database connectivity with example.		
VI	React js	Introduction, React features, App “Hello World” Application, Introduction to JSX, Simple Application using JSX.	05	CO6

Text Books:

1. Ralph Moseley, M.T. Savliya, “**Developing Web Applications**”, Willy India, Second Edition, ISBN: 978-81-265-3867-6
2. “**Web Technology Black Book**”, Dremtech Press, First Edition, 978-7722-997
3. Robin Nixon, “**Learning PHP, MySQL, JavaScript, CSS & HTML5**” Third Edition, O'REILLY, 2014.
4. Dana Moore, Raymond Budd, Edward Benson, “**Professional Rich Internet**

Applications:

- AJAX and Beyond**” Wiley publications. <https://ebooks-it.org/0470082801-ebook.htm>
5. Alex Banks and Eve Porcello, “**Learning React Functional Web Development with React and Redux**”, OREILLY, First Edition

References:

1. Harvey & Paul Deitel& Associates, Harvey Deitel and Abbey Deitel, “**Internet and World Wide Web - How To Program**”, Fifth Edition, Pearson Education, 2011.
2. Achyut S Godbole and AtulKahate, —” **Web Technologies**”, Second Edition, Tata McGraw Hill, 2012.

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3. Thomas A Powell, Fritz Schneider, —” **JavaScript: The Complete Reference**”, Third Edition, Tata McGraw Hill, 2013.
4. David Flanagan, —” **JavaScript: The Definitive Guide**”, Sixth Edition, O'Reilly Media, 2011
5. Steven Holzner —” **The Complete Reference – PHP**”, Tata McGraw Hill, 2008
6. Mike Mcgrath—” **PHP & MySQL in easy Steps**”, Tata McGraw Hill, 2012.

Online References:

Sr. No.	Website Name
1	https://books.goalkicker.com/ReactJSBook/
2	https://www.guru99.com/reactjs-tutorial.html
3	www.nptelvideos.in
4	www.w3schools.com
5	www.coursera.org
6	https://spoken-tutorial.org/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC553	Advance Database Management System	3	-	-	3	-	-	3

		Theory					Ter m work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
CMC553	Advance Database Management System	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide insights into distributed database design principles and architecture.
2. To understand various methods and practices for working with XML and JSON technologies.
3. To explore the types and characteristics of NoSQL databases, with a focus on MongoDB.
4. To study emerging trends and technologies in advanced database systems.
5. To introduce data storage models used in large-scale and cloud-based database applications.

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6. To examine database performance, scalability, and consistency techniques in modern environments.

Course Outcomes:

1. Design distributed databases by applying appropriate techniques for efficient query processing.
2. Analyze query cost and perform distributed transaction management to ensure data consistency and reliability.
3. Organize and structure data using XML and JSON formats to enhance system interoperability.
4. Compare various types of NoSQL databases based on their data models, use cases, and performance.
5. Construct and execute NoSQL queries using MongoDB for real-world data handling scenarios.
6. Describe and illustrate current trends in advanced databases, including temporal, graph-based, and spatial databases.

Prerequisite: Database Management System

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Distributed Databases	Introduction, Distributed DBMS Architecture, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design.	03	CO1
II	Distributed Database Handling	Distributed Transaction Management – Definition, properties, types, architecture Distributed Query Processing - Characterization of Query Processors, Layers/ phases of query processing. Distributed Concurrency Control- Taxonomy,	08	CO2



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		Locking based, Basic TO algorithm, Recovery in Distributed Databases: Failures in distributed database, 2PC and 3PC protocol.		
III	Data interoperability – XML and JSON	XML Databases: Document Type Definition, XML Schema, Querying and Transformation: XPath and XQuery. Basic JSON syntax, (Java Script Object Notation), JSON data types, Stringifying and parsing the JSON for sending & receiving, JSON Object retrieval using key-value pair and JQuery, XML Vs JSON	06	CO3
IV	NoSQL Distribution Model	NoSQL database concepts: NoSQL data modeling, Benefits of NoSQL, comparison between SQL and NoSQL database system. Replication and sharding, Distribution Models Consistency in distributed data, CAP theorem, Notion of ACID Vs BASE, handling Transactions, consistency and eventual consistency. Types of NoSQL databases: Key-value data store, Document database and Column Family Data store, Comparison of NoSQL databases w.r.t CAP theorem and ACID properties.	10	CO4

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V	NoSQL using MongoDB	NoSQL using MongoDB: Introduction to MongoDB Shell, Running the MongoDB shell, MongoDB client, Basic operations with MongoDB shell, Basic Data Types, Arrays, Embedded Documents Querying MongoDB using find() functions, advanced queries using logical operators and sorting, simple aggregate functions, saving and updating document. MongoDB Distributed environment: Concepts of replication and horizontal scaling through sharding in MongoDB	06	CO5
VI	Trends in advance databases	Temporal database: Concepts, time representation, time dimension, incorporating time in relational databases. Graph Database: Introduction, Features, Transactions, consistency, Availability, Querying, Case Study Neo4J Spatial database: Introduction, data types, models, operators and queries	06	CO6

Text Books:

- 1 Korth, Siberchatz, Sudarshan, **“Database System Concepts”**, 6th Edition, McGraw Hill
- 2 Elmasri and Navathe, **“Fundamentals of Database Systems”**, 5th Edition, Pearson Education
3. Ozsu, M. Tamer, Valduriez, Patrick, **“Principles of distributed database systems”**, 3rd Edition, Pearson Education, Inc.
4. Pramod Sadalge, Martin Fowler, **NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence**, Addison Wesley/ Pearson
5. Jeff Friesen, **Java XML and JSON**, Second Edition, 2019, après Inc.

References:

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1. Peter Rob and Carlos Coronel, **“Database Systems Design, Implementation and Management”**, Thomson Learning, 5th Edition.
2. Dr. P.S. Deshpande, **SQL and PL/SQL for Oracle 10g**, Black Book, Dreamtech Press
3. Adam Fowler, **NoSQL for dummies**, John Wiley & Sons, Inc.
4. Shashank Tiwari, **Professional NOSQL**, John Willy & Sons. Inc
5. Raghu Ramkrishnan and Johannes Gehrke, **Database Management Systems**, TMH
6. MongoDB Manual : <https://docs.mongodb.com/manual>

Online References:

Sr. No.	Website Name
1	https://cassandra.apache.org
2	https://www.mongodb.com
3	https://riak.com
4	https://neo4j.com
5	https://martinfowler.com/articles/nosql-intro-original.pdf



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML506	Software Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1+IAT-2				
CML506	Software Engineering Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To solve real-life problems by applying software engineering principles and practices.
2. To impart state-of-the-art knowledge on software engineering concepts, methodologies, and tools.
3. To understand and implement various phases of the software development life cycle (SDLC).
4. To expose students to requirement gathering, analysis, design, coding, testing, and maintenance processes.



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5. To provide hands-on experience with software modeling tools such as UML and CASE tools.
6. To develop teamwork, documentation, and communication skills through real-time project development.

Lab Outcomes:

1. Identify software requirements and apply suitable software process models to a selected case study.
2. Develop architectural and design models to represent the system structure for the case study.
3. Utilize Computer-Aided Software Engineering (CASE) tools for designing and modeling software systems.
4. Construct data flow diagrams, UML diagrams, and other design artifacts for system analysis and design.
5. Implement and test modules of the case study using appropriate development and testing strategies.
6. Evaluate the software project outcomes and documentation for completeness, correctness, and quality standards.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Application of at least two traditional process models.	2
02	Application of the Agile process models.	2
03	Preparation of software requirement specification (SRS) document in IEEE format.	2
04	Structured data flow analysis.	2
05	Use of metrics to estimate the cost.	2

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06	Scheduling & tracking of the project.	2
07	Write test cases for black box testing.	2
08	Write test cases for white box testing.	2
09	Preparation of Risk Mitigation, Monitoring and Management Plan (RMMM).	2
10	Version controlling of the project.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topic from first three units(Introduction To Software Engineering and Process Models, Software Requirements Analysis and Modeling, Software Estimation Metrics) Limited to three questions.	2
02	Assignment covers the topic from last three units(Software Design, Software Testing, Software Configuration Management, Quality Assurance and Maintenance) Limited to three questions.	2

Text Books:

1. Roger Pressman, “**Software Engineering: A Practitioner’s Approach**”, 9th edition , McGraw-Hill Publications, 2019
2. Ian Sommerville, “**Software Engineering**”, 9th edition, Pearson Education, 2011
3. Ali Behfroz and Fredeick J. Hudson, “**Software Engineering Fundamentals**”, Oxford University Press, 1997
4. Grady Booch, James Rumbaugh, Ivar Jacobson, “**The unified modeling language user guide**”, 2nd edition, Pearson Education, 2005

References:



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1. Pankaj Jalote, "An integrated approach to Software Engineering", 3rd edition, Springer, 2005
2. Rajib Mall, "Fundamentals of Software Engineering", 5th edition, Prentice Hall India, 2014
3. Jibitesh Mishra and Ashok Mohanty, "Software Engineering", Pearson , 2011
4. Ugrasen Suman, "Software Engineering – Concepts and Practices", Cengage Learning, 2013
5. Waman S Jawadekar, "Software Engineering principles and practice", McGraw Hill Education, 2004

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/105/106105182/
2.	https://onlinecourses.nptel.ac.in/noc19_cs69/preview
3.	https://www.mooc-list.com/course/software-engineering-introduction-edx

Assessment:

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)

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

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML507	Computer Network Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1+IAT-2				
CML507	Computer Network Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To practically explore OSI layers and understand the usage of simulation tools.
2. To analyze, specify, and design the topological and routing strategies for an IP-based networking infrastructure.
3. To identify the various issues of a packet, transfer from source to destination, and how they are resolved by the various existing protocols.
4. To evaluate the performance of different routing algorithms and their impact on network efficiency.
5. To understand and implement various LAN, WAN, and wireless network configurations using simulation tools.
6. To examine protocol functionalities at different layers and assess their role in



end-to-end communication.

Lab Outcomes:

1. Remember networking commands and Linux-based setup procedures for configuring a network environment.
2. Understand the functionalities of different networking tools and simulators such as NS2 and Wireshark.
3. Apply core programming APIs to implement basic networking concepts and socket programming.
4. Analyze the behavior of networking protocols through simulation and packet inspection.
5. Evaluate the performance of various routing and congestion control algorithms using simulators.
6. Create and configure a complete simulated network scenario to demonstrate communication protocols and services.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of RJ45 and CAT6 Cabling and connection using crimping tool.	2
02	Use basic networking commands in Linux (ping, tracer, nslookup, netstat, ARP, RARP, ip, ifconfig, dig, route)	2
03	Build a simple network topology and configure it for static routing protocol using packet tracer. Setup a network and configure IP addressing, subnetting, masking.	2
04	Perform network discovery using discovery tools (eg. Nmap, mrtg)	2
05	Use Wire shark to understand the operation of TCP/IP layers: • Ethernet Layer: Frame header, Frame size etc. • Data Link Layer: MAC address, ARP (IP and MAC address binding)	2

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	• Network Layer: IP Packet (header, fragmentation), ICMP (Query and Echo) • Transport Layer: TCP Ports, TCP handshake segments etc. • Application Layer: DHCP, FTP, HTTP header formats	
06	Use simulator (Eg. NS2) to understand functioning of ALOHA, CSMA/CD.	2
07	Study and Installation of Network Simulator (NS3) .	2
08	a. Set up multiple IP addresses on a single LAN. b. Using nestat and route commands of Linux, do the following: • View current routing table • Add and delete routes • Change default gateway c. Perform packet filtering by enabling IP forwarding using IPtables in Linux.	2
09	Design VPN and Configure RIP/OSPF using Packet tracer.	2
10	Socket programming using TCP or UDP	2
11	Perform File Transfer and Access using FTP	2
12	Perform Remote login using Telnet server	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topic from first three units(Introduction to Networking ,Physical Layer , Data Link Layer & Medium Access Control sublayer) Limited to three questions.	2
02	Assignment covers the topic from last three units(Network layer , Transport Layer , Application Layer) Limited to three questions.	2

Text Books:



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1. A.S. Tanenbaum, **Computer Networks**, 4th edition Pearson Education
2. B.A. Forouzan, **Data Communications and Networking**, 5th edition, TMH
3. James F. Kurose, Keith W. Ross, **Computer Networking, A Top-Down Approach Featuring the Internet**, 6th edition, Addison Wesley

References:

1. S.Keshav, **An Engineering Approach To Computer Networking**, Pearson
2. Natalia Olifer & Victor Olifer, **Computer Networks: Principles, Technologies & Protocols for Network Design**, Wiley India, 2011
3. Larry L. Peterson, Bruce S. Davie, **Computer Networks: A Systems Approach**, Second Edition, The Morgan Kaufmann Series in Networking

Online Resources:

Sr. No.	Website Name
1	https://www.netacad.com/courses/networking/networking-essentials
2	https://www.coursera.org/learn/computer-networking
3	https://nptel.ac.in/courses/106/105/106105081
4	https://www.edx.org/course/introduction-to-networking

Assessment:

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)

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

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML508	Data Warehousing and Mining Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1+IAT-2				
CML508	Data Warehousing and Mining Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Learn how to build a data warehouse and query it.
2. Learn about data sets and perform data preprocessing tasks.
3. Demonstrate the working of algorithms for data mining tasks such as classification, clustering, association rule mining, and web mining.
4. Apply data mining techniques with varied input values for different parameters.
5. Explore open-source software tools (like WEKA) to perform data mining tasks.
6. Implement and test data mining models on real-world or benchmark datasets

*R-2025- T.E Computer Engineering***Lab Outcomes:**

1. Understand the concepts of data warehousing, data marts, and OLAP operations.
2. Apply OLAP operations (like roll-up, drill-down, slice, and dice) on multidimensional data models.
3. Implement classification algorithms such as decision trees or naïve Bayes for predictive analysis.
4. Develop clustering solutions using algorithms like K-means or hierarchical clustering on sample datasets.
5. Implement association rule mining algorithms like Apriori or FP-Growth to discover patterns.
6. Analyze and interpret results from web mining techniques to extract meaningful insights from web data.

List of Experiments.

Sr No	List of Experiments	Hrs
01	One case study on building Data warehouse/Data Mart □ Write Detailed Problem statement and design dimensional modelling (creation of star and snowflake schema)	2
02	Implementation of all dimension table and fact table based on experiment 1 case study	2
03	Implementation of OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot based on experiment 1 case study	2
04	Implementation of Bayesian algorithm	2
05	Implementation of Data Discretization (any one) & Visualization (any one)	2
06	Perform data Pre-processing task and demonstrate Classification, Clustering, Association algorithm on data sets using data mining tool (WEKA/R tool)	2

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07	Implementation of Clustering algorithm (K-means/K-medoids)	2
08	Implementation of any one Hierarchical Clustering method	2
09	Implementation of Association Rule Mining algorithm (Apriori)	2
10	Implementation of Page rank/HITS algorithm	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topic from first three units(Data Warehousing Fundamentals , Introduction to Data Mining, Data Exploration and Data Pre-processing , Classification) Limited to three questions.	2
02	Assignment covers the topic from last three units Clustering , Mining frequent patterns and associations , Web Mining) Limited to three questions.	2

Text Books:

1. Paulraj Ponniah, **“Data Warehousing: Fundamentals for IT Professionals”**, Wiley India.
2. Han, Kamber, **“Data Mining Concepts and Techniques”**, Morgan Kaufmann 2nd edition.
3. M.H. Dunham, **“Data Mining Introductory and Advanced Topics”**, Pearson Education

References:

1. Reema Theraja, **“Data warehousing”**, Oxford University Press 2009.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, **“Introduction to Data Mining”**, Pearson Publisher 2nd edition.



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DTE Code No: 3423 | Recognized under Section 2(f) of the UGC Act 1956 | Minority Status (Hindi Linguistic)

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3. Ian H. Witten, Eibe Frank and Mark A. Hall, “**Data Mining**”, Morgan Kaufmann
3rd edition.

Online Resources:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc20_cs12/preview
2	https://www.coursera.org/specializations/data-mining

Assessment:

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)

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

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML509	Professional Communication & Ethics II	-	2+2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT -1	IAT-2	IAT-1+IAT-2				
CML509	Professional Communication & Ethics II	--	--	--	--	25	25	50

Lab Objectives:

1. To discern and develop an effective style of writing important technical/business documents.
2. To investigate possible resources and plan a successful job campaign.
3. To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. To develop creative and impactful presentation skills.



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5. To analyze personal traits, interests, values, aptitudes and skills.
6. To understand the importance of integrity and develop a personal code of ethics.

Lab Outcomes:

1. Remember and Understand key elements of business and technical documentation to build a foundation for future managerial roles.
2. Apply personal and professional development strategies to enhance one's professional image in alignment with industry expectations.
3. Analyze group dynamics and contribute constructively to group discussions, meetings, and collaborative decision-making.
4. Create and Deliver persuasive and professional presentations tailored to specific audiences and purposes.
5. Develop and Evaluate creative thinking and interpersonal communication skills essential for professional success.
6. Apply and Uphold ethical conduct, personal integrity, and organizational norms in professional environments.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Preparation of a Formal Technical Report	2
02	Drafting and Submitting a Technical Proposal	2
03	Technical Paper Writing and Formatting	2
04	Cover Letter and Resume Design	2
05	Statement of Purpose (SOP) Writing	2
06	Conducting and Documenting a Business Meeting	2
07	Mock Group Discussion (GD) Session	2
08	Mock Personal Interview with Feedback	2

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09	Creating and Delivering a Technical Presentation	2
10	Case Study Analysis on Corporate Ethics	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topic from first three units(Advanced Technical Writing: Project/Problem Based Learning (Pbl),Employment Skills , Business Meetings) Limited to three questions.	2
02	Assignment covers the topic from last three units (Technical/ Business Presentations, Interpersonal Skills , Corporate Ethics) Limited to three questions.	2

Text 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. Bovee, 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.

References:

1. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson.
2. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice.



Oxford University Press

3. Archana Ram (2018) Place Mentor, Tests of Aptitude for Placement Readiness. Oxford University Press
4. Sanjay Kumar & PushpLata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.

Online Resources:

Sr. No.	Website Name
1	https://ocw.mit.edu/courses/comparative-media-studies-writing/21w-732-science-writing-and-new-media-spring-2013/lecture-notes/
2	https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/proposals.html
3	https://libguides.murdoch.edu.au/IEEE
4	https://www.grammarly.com/plagiarism-checker

Assessment:

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)

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

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML510	Mini Project : 2A	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IA T-1	IAT - 2	IAT- 1+IAT-2				
CML510	Mini Project : 2A	--	--	--	--	25	25	50

Lab Objectives

- 1.To understand and identify the problem
- 2.To apply basic engineering fundamentals and attempt to find solutions to the problems.
3. Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
- 4.To develop communication skills and improve teamwork amongst group members and inculcate the process of self-learning and research.
- 5.Analyze and evaluate the impact of solution/product/research/innovation /entrepreneurship towards societal/environmental/sustainable development
- 6.Develop interpersonal skills to work as a member of a group or as leader



Lab Outcome:

1. Identify societal/research/innovation/entrepreneurship problems through appropriate literature surveys
2. Identify Methodology for solving above problem and apply engineering knowledge and skills to solve it
3. Validate, Verify the results using test cases/benchmark data/theoretical/inferences/experiments/simulations
4. Use standard norms of engineering practices and project management principles during project work
5. Communicate through technical report writing and oral presentation. • The work may result in research/white paper/ article/blog writing and publication • The work may result in business plan for entrepreneurship product created • The work may result in patent filing.
6. Gain technical competency towards participation in Competitions, Hackathons, etc.

Guidelines for Mini Project

1. Mini project may be carried out in one or more form of following:
Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
2. 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.
3. Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor or head of department/internal committee of faculties.
4. Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
5. A logbook may be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6. Faculty supervisors may give inputs to students during mini project activity; however, focus shall be on self-learning.



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7. Students under the guidance of faculty supervisor shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8. The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. Software requirement specification (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
9. With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 2 in semesters V and VI.
10. 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 a case by case basis.

Term Work

The review/ progress monitoring committee shall be constituted by the heads of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, based on the SRS document submitted. 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 25

- 1 Marks awarded by guide/supervisor based on logbook 10
- 2 Marks awarded by review committee 10
- 3 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:

1. In one-year project (sem V and VI), first semester the entire theoretical solution shall be made ready, including components/system selection and cost analysis. Two reviews will be conducted based on a presentation given by a student group.
 - First shall be for finalization of problem
 - Second shall be on finalization of proposed solution of problem.
2. In the 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 the last month of the said semester.

Half-year project:

1. 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
2. Two reviews will be conducted for continuous assessment,
 - First shall be for finalization of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Mini Project shall be assessed based on following points



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1. Clarity of problem and quality of literature Survey for problem identification
 2. Requirement Gathering via SRS/ Feasibility Study
 3. Completeness of methodology implemented
 4. Design, Analysis and Further Plan
 5. Novelty, Originality or Innovativeness of project
 6. Societal / Research impact
 7. Effective use of skill set: Standard engineering practices and Project management standard
 8. Contribution of an individual's as member or leader
 9. Clarity in written and oral communication
 10. Verification and validation of the solution/ Test Cases
 11. Full functioning of working model as per stated requirements
 12. Technical writing /competition/hackathon outcome being met
- In one-year project (sem V and VI), first semester evaluation may be based on first 10 criteria and remaining may be used for second semester evaluation of performance of students in mini projects.
 - In case of half year projects (completing in V sem) all criteria in generic may be considered for evaluation of performance of students in mini projects.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1. Report should be prepared as per the guidelines issued by the University of Mumbai.
2. 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 organizations having experience of more than five years approved by the head of Institution.
3. Students shall be motivated to publish a paper/participate in competition based on the work in Conferences/students competitions.



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Semester-VI



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC601	System Programming and Compiler Construction	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
CMC601	System Program- ming and Com- piler Construction	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the purpose, types, and components of system software and their roles in system programming.
2. To study the design and working of assemblers, including single-pass and two-pass techniques for X86 processors.
3. To understand macros, macro processors, and their implementation and features.
4. To explore the concepts of loaders and linkers and various loading and linking schemes.
5. To understand the analysis phase of compilers, including lexical and syntax analysis techniques and their implementation.
6. To study the synthesis phase of compilers including intermediate code generation, optimization, and final code generation.

Course Outcomes:

1. Recall different types of system software and their functions such as assembler, linker, loader, and compiler.
2. Explain the structure and working of single-pass and two-pass assemblers for X86 architecture.
3. Apply macro processing techniques and implement basic macro expansion using parameterized and nested macros.
4. Analyze the differences between various loader and linker schemes and their role in relocation and linking.

5. Evaluate parsing strategies like LL(1), SLR, and operator precedence in syntax analysis of compilers.
6. Design and implement intermediate code structures and apply optimization techniques to improve code generation.

Prerequisite: Theoretical computer science, Operating system. Computer Organization and architecture.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to System Software	Concept of System Software, Goals of system software, system program and system programming, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.	2	CO1
II	Assemblers	Elements of Assembly Language programming, Assembly scheme, pass structure of assembler, Assembler Design: Two pass assembler Design and single pass Assembler Design for X86 processor, data structures used.	7	CO2
III	Macros and Macro Processor	Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested. Design of Two pass macroprocessor, data structures used.	6	CO3
IV	Loaders and Linkers	Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.	6	CO4



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V	Compilers: Analysis Phase	Introduction to compilers, Phases of compilers: Lexical Analysis- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyzer, data structures used. Syntax Analysis- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- SR Parser, Operator precedence parser, SLR.Semantic Analysis, Syntax directed definitions.	10	CO5
VI	Compilers: Synthesis phase	Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, three address codes: Triples and Quadruples, indirect triple. Code Optimization: Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent. Code Generation: Issues in the design of code generator, code generation algorithm. Basic block and flow graph.	8	CO5

Text Books:

1. D. M Dhamdhare: Systems programming and Operating Systems, Tata McGraw Hill, Revised Second Edition
2. A. V. Aho, R. Shethi, Monica Lam, J.D. Ulman: Compilers Principles, Techniques and Tools, Pearson Education, Second Edition.
3. J. J. Donovan: Systems Programming Tata McGraw Hill, Edition 1991

References:

1. John R. Levine, Tony Mason & Doug Brown, Lex & YACC, O 'Reilly publication, second Edition
2. D, M .Dhamdhare ,Compiler construction 2e, Macmillan publication, second edition .
3. Kenneth C. Loudon ,Compiler construction: principles and practices, Cengage Learning.



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Online References:

Sr. No.	Website Name
1.	http://www.nptelvideos.in/2012/11/compiler-design.html
2.	https://www.coursera.org/lecture/nand2tetris2/unit-4-1-syntax-analysis-5pC2Z



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC602	Cryptography & System Security	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Dura- tion (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC602	Cryptography & System Security	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of cryptography, number theory, and classical encryption techniques.
2. To study symmetric and asymmetric encryption algorithms, key distribution protocols, and public key infrastructure (PKI).
3. To understand cryptographic hash functions and message authentication codes used for data integrity.
4. To explore authentication protocols and digital signature schemes for secure communication.
5. To identify network vulnerabilities and understand security protocols used in securing network communication.
6. To gain knowledge about system-level threats such as buffer overflows, malicious code, and software vulnerabilities.

Course Outcomes:

1. Recall classical encryption techniques and security goals.
2. Explain the principles of symmetric and asymmetric cryptography.
3. Apply cryptographic algorithms to encrypt and decrypt data.
4. Analyze the strengths and weaknesses of hash functions and digital signatures.
5. Evaluate the effectiveness of network security protocols.
6. Design a secure communication system using cryptographic methods.



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Prerequisite: Computer Networks.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction - Number Theory and Basic Cryptography	Security Goals, Attacks, Services and Mechanisms, Techniques. Modular Arithmetic: Euclidean Algorithm, Fermat's and Euler's theorem. Classical Encryption techniques, Symmetric cipher model, mono-alphabetic and polyalphabetic substitution techniques: Vigenere cipher, playfair cipher, Hill cipher, transposition techniques: keyed and keyless transposition ciphers	8	CO1
II	Symmetric and Asymmetric key Cryptography and key Management	Block cipher principles, block cipher modes of operation, DES, Double DES, Triple DES, Advanced Encryption Standard (AES), Stream Ciphers: RC4 algorithm. Public key cryptography: Principles of public key cryptosystems- The RSA Cryptosystem, The knapsack cryptosystem. Symmetric Key Distribution: KDC, Needham-schroeder protocol. Kerberos: Kerberos Authentication protocol, Symmetric key agreement: Diffie Hellman, Public key Distribution: Digital Certificate: X.509, PKI	11	CO2
III	Cryptographic Hash Functions	Cryptographic hash functions, Properties of secure hash function, MD5, SHA-1, MAC, HMAC, CMAC.	3	CO3
IV	Authentication Protocols & Digital Signature Schemes	User Authentication, Entity Authentication: Password Base, Challenge Response Based Digital Signature,	5	CO4

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		Attacks on Digital Signature, Digital Signature Scheme: RSA		
V	Network Security and Applications	Network security basics: TCP/IP vulnerabilities (Layer wise), Network Attacks: Packet Sniffing, ARP spoofing, port scanning, IP spoofing Denial of Service: DOS attacks, ICMP flood, SYN flood, UDP flood, Distributed Denial of Service Internet Security Protocols: PGP, SSL, IPSEC. Network security: IDS, Firewalls	9	CO5
VI	System Security	Buffer Overflow, malicious Programs: Worms and Viruses, SQL injection	3	CO6

Text Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill
3. Behrouz A. Forouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security" 3rd Edition, McGraw Hill

References:

1. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", Second Edition, Wiley.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill Education, 2003.
3. Eric Cole, "Network Security Bible", Second Edition, Wiley, 2011.

Online References:

Sr. No.	Website Name
1.	https://github.com/cmin764/cmiN/blob/master/FII/L3/SI/book/W.Stallings%20-%20Cryptography%20and%20Network%20Security%206th%20ed.pdf
2.	https://docs.google.com/file/d/0B5F6yMKYDUbrYXE4X1ZCUHpLNnc/view



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC603	Mobile Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
CMC603	Mobile Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of mobile computing, cellular systems, and wireless communication technologies.
2. To understand the GSM and GPRS system architectures, protocols, and services including UMTS and UTRAN.
3. To learn about mobile networking concepts and protocols, especially Mobile IP and Mobile TCP mechanisms.
4. To study the architecture and functioning of Wireless Local Area Networks (WLANs), including Wi-Fi and Bluetooth technologies.
5. To explore mobility management techniques, protocols, and mechanisms across IPv4 and IPv6 networks.
6. To understand the evolution of mobile networks, particularly LTE, LTE-Advanced, and the transition toward 5G.

Course Outcomes:

1. Explain the fundamentals of mobile communication, signal propagation, multiplexing techniques, and interference in cellular systems.
2. Describe and compare GSM and GPRS architectures, protocols, and services including security algorithms and UMTS core network improvements.
3. Analyze the working of Mobile IP and Mobile TCP and **evaluate** their enhancements for efficient packet delivery and communication reliability.
4. Illustrate the architecture and working of IEEE 802.11 WLANs and Bluetooth, and apply suitable security measures to protect wireless networks.
5. Differentiate between macro and micro mobility solutions in IPv6 networks and evaluate their roles in seamless handovers and efficient routing.
6. Explain the architecture of LTE and SAE, **compare** the evolution from 2G to 5G, and identify the role of SON and HetNets in next-generation networks.



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Prerequisite: Computer Networks.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Mobile Computing	Introduction to Mobile Computing, Telecommunication Generations, Cellular systems, Electromagnetic Spectrum, Antenna, Signal Propagation, Signal Characteristics, Multiplexing, Spread Spectrum: DSSS & FHSS, Co-channel interference	4	CO1
II	GSM Mobile services	GSM Mobile services, System Architecture, Radio interface, Protocols, Localization and Calling, Handover, security (A3, A5 & A8) GPRS system and protocol architecture UTRAN, UMTS core network; Improvements on Core Network,	8	CO2
III	Mobile Networking	Medium Access Protocol, Internet Protocol and Transport layer Mobile IP: IP Packet Delivery, Agent Advertisement and Discovery, Registration, Tunneling and Encapsulation, Reverse Tunneling. Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Fast Retransmit/ Fast Recovery, Transmission/Timeout Freezing, Selective Retransmission	8	CO3
IV	Wireless Local Area Networks	Wireless Local Area Networks: Introduction, Infrastructure and ad-hoc network IEEE 802.11: System architecture, Protocol architecture, Physical layer, Medium access control layer, MAC management, 802.11a,	6	CO4



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		802.11b standard Wi-Fi security : WEP ,WPA, Wireless LAN Threats , Securing Wireless Networks Bluetooth: Introduction, User Scenario, Architecture, protocol stack		
V	Mobility Management	Mobility Management : Introduction, IP Mobility, Optimization, IPv6 Macro Mobility : MIPv6, FMIPv6 Micro Mobility: CellularIP, HA-WAIL, HMIPv6	6	CO5
VI	Long-Term Evolution (LTE) of 3GPP	Long-Term Evolution (LTE) of 3GPP : LTE System Overview, Evolution from UMTS to LTE LTE/SAE Requirements, SAE Architecture EPS: Evolved Packet System, E-UTRAN, Voice over LTE (VoLTE), Introduction to LTE-Advanced Self Organizing Network (SON-LTE), SON for Heterogeneous Networks(HetNet), Comparison between Different Generations (2G, 3G, 4G and 5G),Introduction to 5G	7	CO6

Text Books:

1. Jochen Schilller, "Mobile Communication", Addison wisely, Pearson Education
2. William Stallings "Wireless Communications & Networks", Second Edition, Pearson Education.
3. Christopher Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications", Wiley publications
4. Raj Kamal, "Mobile Computing", 2/e, Oxford University Press-New

References:

1. Seppo Hamalainen, Henning Sanneck , Cinzia Sartori, "LTE Self-Organizing Networks (SON): Network Management Automation for Operational Efficiency", Wiley publications
2. Ashutosh Dutta, Henning Schulzrinne "Mobility Protocols and Handover Optimization: Design, Evaluation and Application", IEEE Press, Wiley Publication
3. Michael Gregg, "Build your own security lab", Wiley India edition

4. Dipankar Raychaudhuri, Mario Gerla, “Emerging Wireless Technologies and the Future Mobile Internet”, Cambridge
5. Andreas F. Molisch, “Wireless Communications”, Second Edition, Wiley Publication

Online References:

Sr. No.	Website Name
1.	https://www.coursera.org/learn/smart-device-mobile-emerging-technologies
2.	2 https://nptel.ac.in/courses/106/106/106106167/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC604	Artificial Intelligence	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
CMC604	Artificial Intelli- gence	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide an overview of Artificial Intelligence, its history, components, and modern-day applications.
2. To familiarize students with intelligent agents, problem formulation, and search strategies.
3. To explore various problem-solving techniques, including informed and uninformed search methods and optimization algorithms.
4. To introduce knowledge representation methods and reasoning using logic and belief networks.
5. To understand different planning strategies and basic learning paradigms in AI, including reinforcement learning.
6. To expose students to real-world AI applications, especially in natural language processing, robotics, and industry domains like healthcare and banking.

Course Outcomes:

1. Describe the fundamentals, history, and applications of Artificial Intelligence and categorize intelligent systems.
2. Explain the role and structure of intelligent agents and formulate AI problems for search-based solutions.
3. Compare and analyze various search algorithms including uninformed, informed, and local search methods for problem solving.
4. Demonstrate knowledge representation using propositional and first-order logic and apply reasoning techniques in uncertain environments.
5. Apply and evaluate different planning strategies and learning paradigms including reinforcement learning in AI systems.



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6. Illustrate AI applications in natural language processing, robotics, and industrial domains by identifying their challenges and capabilities.

Prerequisite: Discrete Mathematics, Data Structures

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Artificial Intelligence	Introduction, History of Artificial Intelligence, Intelligent Systems: Categorization of Intelligent System, Components of AI Program, Foundations of AI, Sub-areas of AI, Applications of AI, Current trends in AI.	4	CO1
II	Intelligent Agents	Agents and Environments, The concept of rationality, The nature of environment, The structure of Agents, Types of Agents, Learning Agent. Solving problem by Searching: Problem Solving Agent, Formulating Problems, Example Problems.	4	CO2
III	Problem solving	Uninformed Search Methods: Breadth First Search (BFS), Depth First Search (DFS), Depth Limited Search, Depth First Iterative Deepening (DFID), Informed Search Methods: Greedy best first Search, A* Search, Memory bounded heuristic Search. Local Search Algorithms and Optimization Problems: Hill climbing search Simulated annealing, Genetic algorithms. Adversarial Search: Game Playing, Min-Max Search, Alpha Beta Pruning	10	CO3
IV	Knowledge and Reasoning	Knowledge based Agents, Brief Overview of propositional logic, First Order Logic: Syntax and Semantic, Inference in FOL, Forward chaining, backward Chaining. Knowledge Engineering in First-Order	12	CO4

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		Logic, Unification, Resolution Uncertain Knowledge and Reasoning: Uncertainty, Representing knowledge in an uncertain domain, The semantics of belief network, Simple Inference in belief network		
V	Planning and Learning	The planning problem, Planning with state space search, Partial order planning, Hierarchical planning, Conditional Planning. Learning: Forms of Learning, Theory of Learning, PAC learning. Introduction to statistical learning (Introduction only) Introduction to reinforcement learning: Learning from Rewards, Passive Reinforcement Learning, Active reinforcement Learning	5	CO5
VI	AI Applications	Introduction to NLP- Language models, Grammars, Parsing Robotics - Robots, Robot hardware, Problems Robotics can solve AI applications in Healthcare, Retail, Banking	4	CO6

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition" Pearson Education, 2020.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
3. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education.,2005

References:

1. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/105/106105078/
2.	https://thetempedia.com/blog/simple-ai-and-machine-learning-projects-for-studentsand-beginners/
3.	https://nptel.ac.in/courses/106/105/106105079/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC651	Internet of Things	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
CMC651	Internet of Things	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts and architectures of the Internet of Things (IoT), including digitization and its real-world impact.
2. To explore the various physical components used in IoT systems such as sensors, actuators, and smart objects along with their supporting technologies.
3. To understand the IoT functional stack, including sensors, communication networks, data analytics, and smart services.
4. To examine different IoT application protocols, including SCADA systems, CoAP, and MQTT.
5. To study IoT applications across multiple domains such as smart homes, cities, healthcare, industry, logistics, and agriculture.
6. To enable students to design and develop IoT systems using various hardware platforms, software environments, and communication protocols.

Course Outcomes:

1. Describe the architecture, components, and challenges of IoT systems and explain standardized architectures such as oneM2M and IoTWF.
2. **Identify and classify** various sensors, actuators, smart objects, and enabling technologies used in IoT applications.
3. **Explain and differentiate** the layers of the IoT functional stack and **analyze** their roles in end-to-end IoT systems.
4. **Compare** different application protocols used in IoT, including SCADA, CoAP, and MQTT, and **evaluate** their suitability for various IoT use cases.



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5. **Illustrate** the application of IoT solutions in diverse domains such as healthcare, agriculture, retail, and smart cities.
6. **Design and develop** basic IoT solutions using popular hardware (e.g., Arduino, Raspberry Pi) and software platforms, and **evaluate** their performance based on communication standards and development tools.

Prerequisite: C Programming, Digital Logic and Computer Architecture, Microprocessor, Computer Networks.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Internet of Things (IoT)	What is IoT? - IoT and Digitization IoT Impact – Connected Roadways, Connected Factory, Smart Connected Buildings, Smart Creatures Convergence of IT and OT, IoT Challenges. The oneM2M IoT Standardized Architecture. The IoT World Forum (IoTWF) Standardized Architecture. IoT Data Management and Compute Stack – Design considerations and Data related problems, Fog Computing, Edge Computing, The Hierarchy of Edge, Fog and Cloud	7	CO1
II	Things in IoT	Sensors/Transducers – Definition, Principles, Classifications, Types, Characteristics and Specifications Actuators — Definition, Principles, Classifications, Types, Characteristics and Specifications. Smart Object – Definition, Characteristics and Trends Sensor Networks – Architecture of Wireless Sensor Network, Network Topologies.	7	CO2



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		Enabling IoT Technologies - Radio Frequency Identification Technology, MicroElectro-Mechanical Systems (MEMS), NFC (Near Field Communication), Bluetooth Low Energy (BLE), LTE-A (LTE Advanced), IEEE 802.15.4- Standardization and Alliances, ZigBee.		
III	The Core IoT Functional Stack	Layer 1 – Things: Sensors and Actuators Layer. Layer 2 – Communications Network Layer, Access Network Sublayer, Gateways and Backhaul Sublayer, Network Transport Sublayer, IoT Network Management Sublayer. Layer 3 – Applications and Analytics Layer, Analytics Vs. Control Applications, Data Vs. Network Analytics, Data Analytics Vs. Business Benefits, Smart Services	6	CO3
IV	Application Protocols for IoT	The Transport Layer IoT Application Transport Methods Application Layer Protocol Not Present SCADA - Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T Generic Web-Based Protocols IoT Application Layer Protocols – CoAP and MQTT	7	CO4
V	Domain Specific IoTs	Home Automation – Smart Lighting, Smart Appliances, Intrusion Detection, Smoke/Gas Detectors Cities – Smart Parking, Smart Lighting, Smart Roads, Structural Health Monitoring, Surveillance Environment – Weather Monitoring, Air Pollution Monitoring, Noise Pollution Monitoring, Forest Fire Detection, River Floods Detection Energy – Smart Grids, Renewable Energy Systems, Prognostics	6	CO5



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		Retail – Inventory Management, Smart Payments, Smart Vending Machines Logistics – Route Generation & Scheduling, Fleet Tracking, Shipment Monitoring Agriculture – Smart Irrigation, Green House Control Industry – Machine Diagnostics & Prognosis, Indoor Air Quality Monitoring Health & Lifestyle – Health & Fitness Monitoring, Wearable Electronics		
VI	Create your own IoT	IoT Hardware - Arduino, Raspberry Pi, ESP32, Cloudbit/Littlebits, Particle Photon, Beaglebone Black. IoT Software - languages for programming IoT hardware, for middleware applications and API development, for making front ends, REST and JSON-LD A comparison of IoT boards and platforms in terms of computing A comparison of IoT boards and platforms in terms of development environments and communication standards A comparison of boards and platforms in terms of connectivity A comparison of IoT software platforms	6	CO6

Text Books:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton, Jerome Henry, “IoT Fundamentals – Networking Technologies, Protocols, and Use Cases for the Internet of Things”, 1st Edition, Published by Pearson Education, Inc, publishing as Cisco Press, 2017.
2. Hakima Chaouchi, “The Internet of Things - Connecting Objects to the Web”, 1st Edition, Wiley, 2010.
3. Perry Lea, “Internet of things For Architects”, 1st Edition, Packt Publication, 2018
4. Arshdeep Bahga, Vijay Madiseti, “Internet of Things – Hands-On Approach”, 2nd Edition,



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Universities Press, 2016.

References:

1. Adrian McEwen & Hakim Cassimally, “Designing the Internet of Things”, 1st Edition, Wiley, 2014.
2. Donald Norris, “Raspberry Pi – Projects for the Evil Genius”, 2nd Edition, McGraw Hill, 2014.
3. Anand Tamboli, “Build Your Own IoT Platform”, 1st Edition, Apress, 2019.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/105/106105166/
2.	https://nptel.ac.in/courses/108/108/108108098/
3.	https://nptel.ac.in/courses/106/105/106105195/
4.	https://www.coursera.org/specializations/IoT



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC652	Digital Signal & Image Processing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1 + IAT-2					
CMC652	Digital Signal & Image Processing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of discrete-time signals and systems, including sampling, re-construction, and basic signal manipulations.
2. To provide an understanding of the Discrete Fourier Transform (DFT), its properties, and its applications in signal analysis.
3. To explore the need for and implementation of the Fast Fourier Transform (FFT) for efficient spectral analysis.
4. To introduce the basic concepts of digital images, image representation, and standard image file formats.
5. To explain spatial domain techniques for image enhancement using various filtering and transformation methods.
6. To familiarize students with the concepts and techniques used in image segmentation, including edge detection and region-based methods.

Course Outcomes:

1. Describe discrete-time signals and systems and perform basic operations such as convolution and correlation.
2. Analyze discrete signals using DFT and DTFT and apply DFT properties for signal processing.
3. Implement Radix-2 FFT algorithms and demonstrate their use in spectral analysis of signals.
4. Explain the principles of digital image representation and differentiate between various image formats and connectivity models.
5. Apply spatial domain techniques such as histogram equalization, smoothing, and sharpening filters for image enhancement.
6. Evaluate image segmentation techniques based on edge detection and region-based approaches for effective image analysis.



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R-2025- T.E. Computer Engineering

Prerequisite: Applied Engineering Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Discrete-Time Signal and Discrete-Time System	Introduction to Digital Signal Processing, Sampling and Reconstruction, Standard DT Signals, Concept of Digital Frequency, Representation of DT signal using Standard DT Signals, Signal Manipulations (shifting, reversal, scaling, addition, multiplication). Classification of Discrete-Time Signals, Classification of Discrete- Systems Linear Convolution formulation for 1-D signal (without mathematical proof), Circular Convolution (without mathematical proof), Linear convolution using Circular Convolution. Auto and Cross Correlation formula evaluation, Concept of LTI system, Output of DT system using Time Domain Linear Convolution.	10	CO1
II	Discrete Fourier Transform	Introduction to DTFT, DFT, Relation between DFT and DTFT, IDFT Properties of DFT without mathematical proof (Scaling and Linearity, Periodicity, Time Shift and Frequency Shift, Time Reversal, Convolution Property and Parseval's Energy Theorem). DFT computation using DFT properties. Convolution of long sequences, Introduction to 2-D DFT	5	CO2
III	Fast Fourier Transform	Need of FFT, Radix-2 DIT-FFT algorithm, DIT-FFT Flow graph for N=4 and 8, Inverse FFT algorithm. Spectral Analysis using FFT	4	CO3
IV	Digital Image Fundamentals	Introduction to Digital Image, Digital Image Processing System, Sampling and Quantization Representation of Digital Image, Connectivity	5	CO4

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		Image File Formats: BMP, TIFF and JPEG.		
V	Image Enhancement in Spatial domain	Gray Level Transformations, Zero Memory Point Operations, Histogram Processing, Histogram equalization. Neighborhood processing, Image averaging, Image Subtraction, Smoothing Filters - Low pass averaging, Sharpening Filters-High Pass Filter, High Boost Filter, Median Filter for reduction of noise	9	CO5
VI	Image Segmentation	Fundamentals, Segmentation based on Discontinuities and Similarities Point, line and Edge Detection, Image edge detection using Robert, Prewitt and Sobel masks, Image edge Detection using Laplacian mask Region based segmentation: Region Growing, Region Splitting and Merging	6	CO6

Text Books:

1. John G. Proakis, Dimitris and G .Manolakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Edition, Pearson Education, 2007
2. A. Anand Kumar, "Digital Signal Processing", 2nd Edition, PHI Learning Pvt. Ltd. 2014.
3. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education Asia, 4th Edition, 2018.
4. S. Sridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2012.

References:

1. Sanjit Mitra, "Digital Signal Processing: A Computer Based Approach", 4th Edition, Tata McGraw Hill, 2013
2. S. Salivahanan, A. Vallavaraj, and C. Gnanapriya, "Digital Signal Processing", 2nd Edition, Tata McGraw Hill Publication, 2011.
3. S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing", 3rd Edition, Tata McGraw Hill Education Private Ltd, 2009.
5. Anil K. Jain, "Fundamentals of Digital Image Processing", 4th Edition, Prentice Hall of India Private Ltd,.1989



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/
2.	https://swayam.gov.in



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC653	Quantitative Analysis	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT-1 + IAT-2					
CMC653	Quantitative Analysis	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the basic functions, importance, and limitations of statistics, and how to represent data effectively using diagrams and graphs.
2. To learn different data collection techniques and sampling methods for statistical analysis.
3. To introduce the concept of simple linear regression, model components, and performance measures.
4. To understand the formulation and interpretation of multiple linear regression models.
5. To introduce the concepts of statistical inference, including point estimation methods and their properties.
6. To familiarize students with hypothesis testing frameworks, types of errors, and powerful test criteria like the Neyman-Pearson lemma.

Course Outcomes:

1. Explain the functions, importance, and limitations of statistics and demonstrate data representation using classification, tabulation, and graphical tools.
2. Differentiate between primary and secondary data sources and apply appropriate sampling techniques for statistical studies.
3. Construct and interpret simple linear regression models using concepts like intercept, slope, error term, and goodness-of-fit metrics.
4. Develop and analyze multiple linear regression models, including testing the significance of coefficients and the overall model.
5. Explain the concepts of statistical inference and evaluate estimators using methods like moments and maximum likelihood estimation.
6. Formulate and test statistical hypotheses using appropriate test procedures, considering different types of errors and decision criteria.



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Prerequisite: Applied Mathematics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Statistics	Functions – Importance – Uses and Limitations of Statistics. Statistical data–Classification, Tabulation, Diagrammatic & Graphic representation of data	6	CO1
II	Data Collection & Sampling Methods	Primary & Secondary data, Sources of data, Methods of collecting data. Sampling – Census & Sample methods –Methods of sampling, Probability Sampling and Non-Probability Sampling.	6	CO2
III	Introduction to Regression	Mathematical and Statistical Equation – Meaning of Intercept and Slope – Error term – Measure for Model Fit – R^2 – MAE – MAPE.	8	CO3
IV	Introduction to Multiple Linear Regression	Multiple Linear Regression Model, Partial Regression Coefficients, Testing Significance overall significance of Overall fit of the model, Testing for Individual Regression Coefficients	8	CO4
V	Statistical inference	Random sample -Parametric point estimation unbiasedness and consistence- method of moments and method of maximum likelihood.	6	CO5
VI	Tests of hypotheses	Null and Alternative hypotheses. Types of errors. Neyman-Pearson lemma-MP and UMP tests.	5	CO6

Text Books:

1. Agarwal, B.L. (2006):-Basic Statistics. Wiley Eastern Ltd., New Delhi
2. Gupta, S. P. (2011):-Statistical Methods. Sultanchand&Sons, New Delhi
3. Sivathanupillai, M & Rajagopal, K. R. (1979):-Statistics for Economics Students.
4. Hogg, R.V. and Craig, A.T.(2006), An introduction to mathematical statistics, Amerind publications.



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References:

1. Arora, P.N., Sumeet Arora, S. Arora (2007):- Comprehensive Statistical Methods. Sultan Chand, New Delhi
2. Montgomery, D.C., Peck E.A., & Vining G.G. (2003). Introduction to Linear Regression Analysis. John Wiley and Sons, Inc. NY
3. Mood AM, Graybill FA, and Boes, D.C. (1985), Introduction to the theory of statistics, McGrawhill Book Company, New Delhi.
4. Kapur, J.N. and Saxena, H.C. (1970), Mathematical statistics, Sultan Chand & company, New Delhi.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML606	System Programming and Compiler Construction Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML606	System Programming and Compiler Construction Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand and develop the functionality of a two-pass assembler including symbol table and code generation.
2. To learn the structure and design of a macro processor that handles different macro types through a two-pass approach.
3. To implement a lexical analyzer that identifies tokens using regular expressions and finite automata.
4. To construct parsers using syntax analysis techniques such as LL(1), operator precedence, or SLR parsing.
5. To generate intermediate code representations of high-level programming languages for further translation.
6. To study and apply tools like LEX and YACC for automating lexical and syntax analysis processes.

*R-2025- T.E Computer Engineering***Lab Outcomes:**

1. Recall the key concepts and phases of compiler and assembler design.
2. Explain the working of lexical analyzers and macro processors, including their internal data structures.
3. Apply parsing techniques to construct a parser for a given grammar.
4. Analyze and implement the differences in intermediate code formats like three-address code, postfix, and syntax trees.
5. Evaluate the correctness and efficiency of code generation and optimization techniques in compiler Design.
6. Design and develop a compiler module using LEX and YACC tools to handle lexical and syntax Analysis automatically.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Implementations of two pass Assembler.	2
02	Implementation of Two pass Macro Processor.	2
03	Implementation of Lexical Analyzer.	2
04	Implementation of Parser (Any one).	2
05	Implementation of Intermediate code generation phase of compiler.	2
06	Implementation of code generation phase of compiler.	2
07	Study and implement experiments on LEX, YACC.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment Cover topics from first three modules (Introduction to System Software, Assemblers, Macros and Macro Processor) limited to 3 questions.	2



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02	Assignment Cover topics from last three modules (Loaders and Linkers, Compilers: Analysis Phase, Compilers: Synthesis phase) limited to 3 questions.	2

References:

1. Andrew W. Appel Princeton University. Jens Palsberg Modern Compiler. Implementation in Java, Second Edition. Purdue University. CAMBRIDGE University press @2002.
2. Charles N. Fischer, Richard J. LeBlanc Crafting a compiler with C , pearson Education 2007

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML607	Cryptography & System Security Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML607	Cryptography & System Security Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand and implement various classical and modern cryptographic algorithms for confidentiality and key exchange.
2. To evaluate hashing algorithms for message integrity and analyze their performance.
3. To explore and use network reconnaissance and packet analysis tools for identifying vulnerabilities.
4. To simulate and analyze network attacks such as ARP spoofing, DoS, and SQL injection.
5. To configure and test host and network-level security mechanisms such as firewalls, IPsec, Snort, and GPG.
6. To encourage independent learning through seminars or case studies on advanced cybersecurity topics.

**Lab Outcomes:**

1. Recall key cryptographic techniques and common network security tools used in cybersecurity.
2. Explain the purpose and working of reconnaissance, sniffing, and scanning tools like Wireshark and Nmap.
3. Apply RSA, Diffie-Hellman, hashing, and encryption techniques to secure and validate message integrity.
4. Analyze captured packets and logs to identify malicious behaviors like ARP spoofing, SQL injection, and DoS attacks.
5. Evaluate the effectiveness of firewalls, IPsec, IDS (Snort), and cryptographic APIs in real-world scenarios.
6. Design and configure a secure network setup using layered tools and techniques (e.g., iptables, GPG, Snort) and simulate attack-defense scenarios.

List of Experiments.

Sr. No	Title of Experiment	Hours
1	Design and Implementation of a product cipher using Substitution and Transposition ciphers.	2
2	Implementation and analysis of RSA crypto system.	2
3	Implementation of Diffie Hellman Key exchange algorithm	2
4	For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs.	2
5	Study the use of network reconnaissance tools like WHOIS, dig, traceroute, nslookup to gather information about networks and domain registrars.	2
6	Study of packet sniffer tools: wireshark,: 1. Download and install wireshark and capture icmp, tcp, and http packets in promiscuous mode. 2. Explore how the packets can be traced based on different filters.	2
7	Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp port scan, udp port scan, xmas scan etc.	2

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8	Detect ARP spoofing using nmap and/or open-source tool ARPWATCH and wireshark. Use arping tool to generate gratuitous arps and monitor using wireshark	2
9	Simulate DOS attack using Hping, hping3 and other tools	2
10	Simulate buffer overflow attack using Ollydbg, Splint, Cpp check etc	2
11	a. Set up IPSEC under LINUX. b. Set up Snort and study the logs.	2
12	Setting up personal Firewall using iptables	2
13	Explore the GPG tool of linux to implement email security	2
14	SQL injection attack, Cross-Cite Scripting attack simulation	2
15	Case Study /Seminar: Topic beyond syllabus related to topics covered.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment Cover topics from first three modules (Introduction - Number Theory and Basic Cryptography, Symmetric and Asymmetric key Cryptography and key Management, Cryptographic Hash Functions) limited to 3 questions.	2
02	Assignment Cover topics from last three modules (Authentication Protocols & Digital Signature Schemes, Network Security and Applications, System Security) limited to 3 questions.	2

Text Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practice", 6th Edition, Pearson Education, March 2013
2. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata McGraw Hill
3. Behrouz A. Forouzan & Debdeep Mukhopadhyay, "Cryptography and Network Security" 3rd Edition, McGraw Hill



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References:

1. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", Second Edition, Wiley.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw-Hill Education, 2003.
3. Eric Cole, "Network Security Bible", Second Edition, Wiley, 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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML608	Mobile Computing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML608	Mobile Computing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand and implement wireless communication protocols such as Bluetooth, CDMA, GSM, and Wi-Fi.
2. To explore wireless networking problems like hidden/exposed terminal issues and study solutions like RTS/CTS.
3. To study and configure wireless access points and analyze range and connectivity under different conditions.
4. To investigate and use wireless security tools for monitoring and securing wireless networks.
5. To develop mobile applications using GUI, graphics, database integration, GPS, and alert mechanisms.
6. To design and deploy real-time applications such as calculators or alert systems on physical



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mobile devices.

Lab Outcomes:

1. Recall and describe the working principles of Bluetooth, CDMA, GSM, and Wi-Fi protocols.
2. Explain the issues in wireless networks (e.g., hidden/exposed terminal problems) and how RTS/CTS mitigates them.
3. Apply knowledge to configure a wireless access point and measure communication range between AP and BS.
4. Analyze wireless network behavior and retransmission rates with and without RTS/CTS in a given network simulation.
5. Evaluate the effectiveness of security tools like Kismet and NetStumbler in identifying network vulnerabilities.
6. Design and implement mobile applications integrating GUI, GPS, databases, and event-driven programming, and deploy them on real devices.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Implementation a Bluetooth network with application as transfer of a file from one device to another.	2
02	To implement a basic function of Code Division Multiple Access (CDMA).	2
03	Implementation of GSM security algorithms (A3/A5/A8)	2
04	Illustration of Hidden Terminal/Exposed terminal Problem. Consider two Wi-fi base stations (STA) and an access point (AP) located along the x-axis. All the nodes are fixed. The AP is situated at the middle of the two STA, the distance of separation being 150 m. [variable]. Node #0 and node #1 are the hidden terminals. Both are transmitting some data to the AP (almost at same rate) at the same time. The loss across the wireless link between each STA and the AP is fixed at 50 dB irrespective of the distance of separation. To study how RTS/CTS helps in wireless networks, 1. No RTS/CTS is being sent. 2. Nodes do exchange RTS/CTS packets.	2

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	Compare the no. of packet retransmissions required in both the cases (as obtained in the output) and compare the results.	
05	To setup & configuration of Wireless Access Point (AP). Analyze the Wi-Fi communication range in the presence of the access point (AP) and the base station (BS). Consider BS and AP are static. Find out the maximum distance to which two way communications is possible. Try multiple iterations by adjusting its distance in the code and test it.	2
06	Study of security tools (like Kismet, Netstumbler)	2
07	Develop an application that uses GUI components.	2
08	Write an application that draws basic graphical primitives on the screen.	2
09	Develop an application that makes use of database.	2
10	Develop a native application that uses GPS location information.	2
11	Implement an application that creates an alert upon receiving a message.	2
12	Implementation of income tax/loan EMI calculator and deploy the same on real devices (Implementation of any real time application)	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment Cover topics from first three modules (Introduction to Mobile Computing, GSM Mobile services, Mobile Networking) limited to 3 questions.	2
02	Assignment Cover topics from last three modules (Wireless Local Area Networks, Mobility Management, Long-Term Evolution (LTE) of 3GPP) limited to 3 questions.	2



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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.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML609	Artificial Intelligence Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML609	Artificial Intelligence Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To explore real-world AI applications through research-based case studies from reputed journals like IEEE, ACM, or Springer.
2. To formulate AI problems using state-space representation and define PEAS (Performance measure, Environment, Actuators, Sensors) for intelligent agents.
3. To implement and compare various search strategies, including uninformed and informed search methods.
4. To apply game-playing algorithms such as Minimax and Alpha-Beta pruning for decision-making in adversarial environments.
5. To implement knowledge representation and reasoning using First Order Logic (FOL).
6. To develop and simulate probabilistic reasoning systems using Bayesian Belief Networks.



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Lab Outcomes:

1. Recall the components of intelligent agents and different types of search algorithms used in AI.
2. Explain PEAS models and state-space formulations for a variety of AI problems.
3. Apply uninformed and informed search algorithms (like BFS, DFS, A*, Greedy) to solve pathfinding problems.
4. Analyze the performance of game-playing algorithms like Minimax and Alpha-Beta pruning in different scenarios.
5. Evaluate logical inference using First Order Logic and determine consistency in knowledge bases.
6. Design and implement a Bayesian Belief Network to perform reasoning under uncertainty.

List of Experiments.

Sr No	List of Experiments	Hrs
01	One case study on AI applications published in IEEE/ACM/Springer or any prominent journal.	2
02	Assignments on State space formulation and PEAS representation for various AI applications	2
03	Program on uninformed search methods.	2
04	Program on informed search methods.	2
05	Program on Game playing algorithms.	2
06	Program for first order Logic	2
07	Program for first order Logic	2
08	Implementation for Bayes Belief Network	2

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Sr No	List of Assignments / Tutorials	Hrs
01	Assignment Cover topics from first three modules (Introduction to Artificial Intelligence, Problem solving) limited to 3 questions.	2
02	Assignment Cover topics from last three modules (Knowledge and Reasoning, Planning and Learning, AI Applications) limited to 3 questions.	2

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition" Pearson Education, 2020.
2. Saroj Kaushik, "Artificial Intelligence", Cengage Learning, First edition, 2011
3. George F Luger, "Artificial Intelligence" Low Price Edition, Fourth edition, Pearson Education.,2005

References:

1. Nils J. Nilsson, Principles of Artificial Intelligence, Narosa Publication.
2. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Publication
3. Patrick H. Winston, Artificial Intelligence, 3rd edition, Pearson Education.
4. Elaine Rich and Kevin Knight, "Artificial Intelligence", Third Edition, McGraw Hill Education,2017.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106/105/106105078/
2.	https://thetempedia.com/blog/simple-ai-and-machine-learning-projects-for-studentsand-beginners/
3.	https://nptel.ac.in/courses/106/105/106105079/



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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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML610	Cloud Computing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML610	Cloud Computing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To introduce the fundamentals of cloud computing, its characteristics, service models (IaaS, PaaS, SaaS), and deployment models.
2. To understand and implement virtualization technologies including hosted and bare-metal hypervisors such as VirtualBox, KVM, Xen, and VMware ESXi.
3. To demonstrate various cloud services such as IaaS, PaaS, Storage as a Service, and DBaaS using platforms like AWS and Microsoft Azure.
4. To explore and implement cloud security practices and identity & access management using AWS and Azure services.
5. To understand and deploy containerized applications using Docker and manage them using Kubernetes orchestration.
6. To develop a comprehensive mini-project integrating multiple cloud services and deployment techniques for real-time application hosting.



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Lab Outcomes:

1. Implement different types of virtualization techniques.
2. Analyze various cloud computing service models and implement them to solve the given problems.
3. Design and develop real world web applications and deploy them on commercial cloud(s).
4. Explain major security issues in the cloud and mechanisms to address them.
5. Explore various commercially available cloud services and recommend the appropriate one for the given application.
6. Implement the concept of containerization

List of Experiments.

Sr No	List of Experiments	Hrs
01	Title: Introduction and overview of cloud computing. Objective: To understand the origin of cloud computing, cloud cube model, NIST model, characteristics of cloud, different deployment models, service models, advantages and disadvantages.	2
02	Title: To study and implement Hosted Virtualization using VirtualBox & KVM. Objective: To know the concept of Virtualization along with their types, structures and mechanisms. This experiment should have demonstration of creating and running Virtual machines inside hosted hypervisors like VirtualBox and KVM with their comparison based on various virtualization parameters.	2
03	Title: To study and Implement Bare-metal Virtualization using Xen, HyperV or VMware Esxi. Objective: To understand the functionality of Bare-metal hypervisors and their relevance in cloud computing platforms. This experiment should have demonstration of install, configure and manage Bare Metal hypervisor along with instructions to create and run virtual machines inside it. It should also emphasize on accessing VMs in different environments along with additional services provided by them like Load balancing, Auto-Scaling, Security etc.	4
04	Title: To study and Implement Infrastructure as a Service using AWS/Microsoft Azure.	4

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	Objective: To demonstrate the steps to create and run virtual machines inside Public cloud platform. This experiment should emphasize on creating and running Linux/Windows Virtual machine inside Amazon EC2 or Microsoft Azure Compute and accessing them using RDP or VNC tools.	
05	Title: To study and Implement Platform as a Service using AWS Elastic Beanstalk/ Microsoft Azure App Service. Objective: To demonstrate the steps to deploy Web applications or Web services written in different languages on AWS Elastic Beanstalk/ Microsoft Azure App Service.	4
06	Title: To study and Implement Storage as a Service using Own Cloud/ AWS S3, Glaciers/ Azure Storage. Objective: To understand the concept of Cloud storage and to demonstrate the different types of storages like object storage, block level storages etc. supported by Cloud Platforms like Own Cloud/ AWS S3, Glaciers/ Azure Storage.	4
07	Title: To study and Implement Database as a Service on SQL/NOSQL databases like AWS RDS, AZURE SQL/ MongoDB Lab/ Firebase. Objective: To know the concept of Database as a Service running on cloud and to demonstrate the CRUD operations on different SQL and NOSQL databases running on cloud like AWS RDS, AZURE SQL/ Mongo Lab/ Firebase.	2
08	Title: To study and Implement Security as a Service on AWS/Azure Objective: To understand the Security practices available in public cloud platforms and to demonstrate various Threat detection, Data protection and Infrastructure protection services in AWS and Azure.	3
09	Title: To study and implement Identity and Access Management (IAM) practices on AWS/Azure cloud. Objective: To understand the working of Identity and Access Management IAM in cloud computing and to demonstrate the case study based on Identity and Access Management (IAM) on AWS/Azure cloud platform.	2
10	Title: To study and Implement Containerization using Docker Objective: To know the basic differences between Virtual machine and Container. It involves demonstration of creating, finding, building, installing, and running Linux/Windows application containers inside local machine or cloud platform.	4
11	Title: To study and implement container orchestration using Kubernetes Objective: To understand the steps to deploy Kubernetes Cluster on local systems, deploy applications on Kubernetes, creating a Service in	4

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	Kubernetes, develop Kubernetes configuration files in YAML and creating a deployment in Kubernetes using YAML,	
12	Mini-project: Design a Web Application hosted on public cloud platform [It should cover the concept of IaaS, PaaS, DBaaS, Storage as a Service, Security as a Service etc.]	4

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. Chelladurai, NeependraKhare, "Docker Cookbook - Second Edition", Packt publication
7. Jonathan Baier, "Getting Started with Kubernetes-Second Edition", Packt Publication.

Digital Material:		
Sr. No.	Topic	Link
1	Introduction and overview of cloud computing	https://www.nist.gov/system/files/documents/itl/cloud/NIST_SP-500-291_Version-2_2013_June18_FINAL.pdf
2	Hosted Virtualization using KVM	https://phoenixnap.com/kb/ubuntu-install-kvm
3	Baremetal Virtualization using Xen	https://docs.citrix.com/en-us/xenserver/7-1/install.html
4	IaaS, PaaS, STaaS, DbaaS, IAM and Security as a Service on AWS and Azure	1) AWS https://docs.aws.amazon.com/ 2) MS Azure https://docs.microsoft.com/en-us/azure
5	Docker	https://docs.docker.com/get-started/
6	Kubernetes	https://kubernetes.io/docs/home/



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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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML611	Mini Project 2B	-	2	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	IAT-1 + IAT-2				
CML611	Mini Project 2B	--	--	--	--	25	25	50

Objectives

1	To understand and identify the problem
2	To apply basic engineering fundamentals and attempt to find solutions to the problems.
3	Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
4	To develop communication skills and improve teamwork amongst group members and inculcate the process of self-learning and research.

Outcome: Learner will be able to...

1	Identify societal/research/innovation/entrepreneurship problems through appropriate literature surveys
2	Identify Methodology for solving above problem and apply engineering knowledge and skills to solve it
3	Validate, Verify the results using test cases/benchmark data/theoretical/inferences/experiments/simulations
4	Analyze and evaluate the impact of solution/product/research/innovation /entrepreneurship towards societal/environmental/sustainable development

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5	Use standard norms of engineering practices and project management principles during project work
6	Communicate through technical report writing and oral presentation. The work may result in research/white paper/ article/blog writing and publication The work may result in business plan for entrepreneurship product created The work may result in patent filing.
7	Gain technical competency towards participation in Competitions, Hackathons, etc.
8	Demonstrate capabilities of self-learning, leading to lifelong learning.
9	Develop interpersonal skills to work as a member of a group or as leader
Guidelines for Mini Project	
1	Mini project may be carried out in one or more form of following: Product preparations, prototype development model, fabrication of set-ups, laboratory experiment development, process modification/development, simulation, software development, integration of software (frontend-backend) and hardware, statistical data analysis, creating awareness in society/environment etc.
2	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.
3	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.
4	Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
5	A logbook may be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
6	Faculty supervisors may give inputs to students during mini project activity; however, focus shall be on self-learning.
7	Students under the guidance of faculty supervisor shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai. Software requirement specification (SRS) documents, research papers, competition certificates may be submitted as part of annexure to the report.
9	With the focus on self-learning, innovation, addressing societal/research/innovation problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 2 in semesters V and VI.
10	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

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	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 a case by case basis.

Term Work:

The review/ progress monitoring committee shall be constituted by the heads of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, based on the SRS document submitted. 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 25
1	Marks awarded by guide/supervisor based on logbook	10
2	Marks awarded by review committee	10
3	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:		
1	In the first semester the entire theoretical solution shall be made ready, including components/system selection and cost analysis. Two reviews will be conducted based on a presentation given by a student group. First shall be for finalization of problem Second shall be on finalization of proposed solution of problem.	
2	In the 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 the last month of the said semester.	
Half-year project:		
1	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	
2	Two reviews will be conducted for continuous assessment, First shall be for finalization of problem and proposed solution Second shall be for implementation and testing of solution.	



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Mini Project shall be assessed based on following points	
1	Clarity of problem and quality of literature Survey for problem identification
2	Requirement gathering via SRS/ Feasibility Study
3	Completeness of methodology implemented
4	Design, Analysis and Further Plan
5	Novelty, Originality or Innovativeness of project
6	Societal / Research impact
7	Effective use of skill set : Standard engineering practices and Project management standard
8	Contribution of an individual's as member or leader
9	Clarity in written and oral communication
10	Verification and validation of the solution/ Test Cases
11	Full functioning of working model as per stated requirements
12	Technical writing /competition/hackathon outcome being met

In one year project (sem V and VI), first semester evaluation may be based on first 10 criteria and remaining may be used for second semester evaluation of performance of students in mini projects.

In case of half year projects (completing in VI sem) all criteria's in generic may be considered for evaluation of performance of students in mini projects.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	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 organizations having experience of more than five years approved by the head of Institution.
3	Students shall be motivated to publish a paper/participate in competition based on the work in Conferences/students competitions.



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B.E Syllabus Semester-VII



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC701	Machine Learning	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC701	Machine Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the basic concepts and techniques of Machine Learning.
- 2 To select, apply and evaluate an appropriate machine learning model for the given application.
- 3 To demonstrate ensemble techniques to combine predictions from different models.
- 4 To demonstrate learning with Classification.
- 5 To demonstrate learning with Clustering.
- 6 To demonstrate the dimensionality reduction techniques.

Course Outcomes:

- 1 To acquire fundamental knowledge of developing machine learning models.
- 2 To select, apply and evaluate an appropriate machine learning model for the given application.
- 3 To demonstrate ensemble techniques to combine predictions from different models.
- 4 To demonstrate learning with Classification.



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- 5 To demonstrate learning with Clustering.
- 6 To demonstrate the dimensionality reduction techniques.

Prerequisite: Engineering Mathematics, Data Structures, Algorithms

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Machine Learning	Machine Learning, Types of Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps in developing a Machine Learning Application. Training Error, Generalization error, Overfitting, Underfitting, Bias-Variance trade-off.	04	CO1
II	Learning with Regression and Trees	Learning with Regression: Linear Regression, Multivariate Linear Regression, Logistic Regression. Learning with Trees: Decision Trees, Constructing Decision Trees using Gini Index (Regression), Classification and Regression Trees (CART) Performance Metrics: Confusion Matrix, [Kappa Statistics], Sensitivity, Specificity, Precision, Recall, F-measure, ROC curve	09	CO2



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III	Ensemble Learning	Understanding Ensembles, K-fold cross validation, Boosting, Stumping, XGBoost Bagging, Subbagging, Random Forest, Comparison with Boosting, Different ways to combine classifiers	06	CO3
IV	Learning with Classification	Support Vector Machine Constrained Optimization, Optimal decision boundary, Margins and support vectors, SVM as constrained optimization problem, Quadratic Programming, SVM for linear and nonlinear classification, Basics of Kernel trick. Support Vector Regression, Multiclass Classification	08	CO4
V	Learning with Clustering	Introduction to clustering with overview of distance metrics and major clustering approaches. Graph Based Clustering: Clustering with minimal spanning tree Model based Clustering: Expectation Maximization Algorithm, Density Based Clustering: DBSCAN	07	CO5
VI	Dimensionality Reduction	Dimensionality Reduction Techniques, Principal Component Analysis, Linear Discriminant Analysis, Singular Valued Decomposition.	05	CO6



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Text Books:

1. Peter Harrington, —Machine Learning in Action, DreamTech Press
2. Ethem Alpaydm, —Introduction to Machine Learning, MIT Press
3. Tom M. Mitchell, —Machine Learning, McGraw Hill
4. Stephen Marsland, —Machine Learning An Algorithmic Perspective, CRC Press

References:

1. Han Kamber, —Data Mining Concepts and Techniques, Morgan Kaufmann Publishers
2. Margaret. H. Dunham, —Data Mining Introductory and Advanced Topics, Pearson Education
3. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective
4. Samir Roy and Chakraborty, —Introduction to soft computing, Pearson Edition.
5. Richard Duda, Peter Hart, David G. Stork, —Pattern Classification, Second Edition, Wiley Publications.

Online References:

Sr. No.	Website Name
1.	Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2.	Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3.	Machine Learning from Coursera
4.	https://towardsdatascience.com/machine-learning/home
5.	https://onlinecourses.nptel.ac.in/noc21_cs85/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC702	Big Data Analysis	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC702	Big Data Analysis	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce big data platforms, their architecture, and real-world applications.
- 2 To explore the Hadoop ecosystem and its core components.
- 3 To develop basic programming skills using MapReduce, NoSQL, and R.
- 4 To understand techniques for scalable and streaming big data analytics.
- 5 To apply big data tools for solving real-world decision-making problems.
- 6 To gain hands-on experience in implementing practical big data solutions.

Course Outcomes:

- 1 Understand the building blocks of Big Data Analytics.
- 2 Apply fundamental enabling techniques like Hadoop and MapReduce in solving real world problems.
- 3 Understand different NoSQL systems and how it handles big data.
- 4 Apply advanced techniques for emerging applications like stream analytics.
- 5 Achieve adequate perspectives of big data analytics in various applications like recommender systems, social media applications, etc.
- 6 Apply statistical computing techniques and graphics for analyzing big data.



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Prerequisite: Database, Data mining.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Big Data and Hadoop	Introduction to Big Data - Big Data characteristics and Types of Big Data Traditional vs. Big Data business approach Case Study of Big Data Solutions Concept of Hadoop, Core Hadoop Components; Hadoop Ecosystem	02	CO1
II	Hadoop HDFS and MapReduce	Distributed File Systems: Physical Organization of Compute Nodes, Large-Scale File-System Organization. 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 Hadoop Limitations	08	CO2



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III	NoSQL	Introduction to NoSQL, NoSQL Business Drivers NoSQL Data Architecture Patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns, NoSQL Case Study NoSQL solution for big data, Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; NoSQL systems to handle big data problems.	10	CO3
IV	Mining Data Streams	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing. Sampling Data techniques in a Stream Filtering Streams: Bloom Filter with Analysis. Counting Distinct Elements in a Stream, Count-Distinct Problem, 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, Decaying Windows.	11	CO4



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V	Real-Time Big Data Models	A Model for Recommendation Systems, Content-Based Recommendations, Collaborative Filtering Case Study: Product Recommendation Social Networks as Graphs, Clustering of Social-Network Graphs, Direct Discovery of Communities in a social graph	04	CO5
VI	Data Analytics with R	Exploring Basic features of R, Exploring RGUI, Exploring RStudio, Handling Basic Expressions in R, Variables in R, Working with Vectors, Storing and Calculating Values in R, Creating and using Objects, Interacting with users, Handling data in R workspace, Executing Scripts, Creating Plots, Accessing help and documentation in R Reading datasets and Exporting data from R, Manipulating and Processing Data in R, Using functions instead of script, built-in functions in R Data Visualization: Types, Applications	04	CO6

Text Books:

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets, Cambridge University Press
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book, Dreamtech Press
5. EMC Education Services, Data Science and Big Data Analytics, Wiley



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References:

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In HugeData StreamsWithAdvancedAnalytics, Wiley
2. Chuck Lam, —Hadoop inAction, Dreamtech Press
3. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.
4. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
7. Vojislav Kecman, —Learning and Soft Computing, MIT Press, 2010.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106104189
3.	https://www.coursera.org/specializations/big-data#courses
3.	https://www.digimat.in/nptel/courses/video/106106169/L01.html
4.	https://www.coursera.org/learn/nosql-databases#syllabus
5.	https://www.coursera.org/learn/basic-recommender-systems#syllabus



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC731	Machine Vision	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC731	Machine Vision	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the need and significance of Machine Vision in real-world applications.
- 2 To explore the fundamental concepts and techniques of image processing.
- 3 To examine the core components and architecture of a Machine Vision System.
- 4 To study various image transformation, interpolation, and filtering techniques.
- 5 To develop the ability to apply image processing for object detection and recognition.
- 6 To build practical applications using Machine Vision tools and frameworks.

Course Outcomes:

- 1 Elaborate the components of Machine Vision Application
- 2 Perform image ,video preprocessing operations
- 3 Explain various transformations, interpolation.
- 4 Elaborate motion tracking in video.
- 5 Analyze and Implement appropriate filtering techniques for a given problem.
- 6 Develop applications based on machine vision.



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Prerequisite: Computer Graphics

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Machine Vision	Computer and Human Vision Systems., The Human Eye, Computer versus Human Vision Systems, Evolution of Computer Vision, Computer/Machine Vision and Image Processing, Applications of Computer Vision	04	CO1
II	Digital Image Fundamentals	Digital Image, Monochrome and Color Images, Image Brightness and Contrast., 2D, 3D, and 4D Images, Digital Image Representation , Digital Image File Formats, Fundamental Image Operations, Points, Edges, and Vertices , Point Operations , Thresholding ,Brightness, Geometric Transformations , Spatial Transformation , Affine Transformation, Image Interpolation, Nearest-Neighbor Interpolation ,Bilinear Interpolation , Bi-cubic Interpolation ,Fundamental Steps in Digital Image Processing.	08	CO2



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III	Machine Vision and System Components	Machine Vision System, Machine Vision Camera: CCD and CMOS Image Sensors, TDI Sensor, Camera Type - Area Scan Cameras, Line Scan Cameras, Smart Cameras, Camera Lens-Resolution, Contrast and Sharpness, Lenses and their parameters: Types of Lenses, Lens Mounts, Lens Selection Examples-Field of View Much larger than Camera sensor size or Smaller or close to Camera Sensor size, Machine Vision Lighting: Lighting: Light Sources in Machine Vision, Illumination Techniques-Backlighting, Front Lighting, Diffused Lighting, Oblique Lighting, Dark Field Lighting, Infrared and Ultraviolet Light, Filters, Machine Vision Software, Machine Vision Automation, Integration of Machine Vision Components	08	CO3



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IV	Digital Image Processing for Machine Vision Applications	Preprocessing., Image Filtering, Normalized Box Filter Gaussian Filter Bilateral Filter, Comparison of Filter Techniques, Sub sampling/Scaling Histogram, Image Segmentation, Threshold- Based Segmentation Edge-Based Segmentation First-Order Derivative Edge Detection. Second-Order Derivative Operators, Comparison of Edge Detection Techniques, Region-Based Segmentation Region Growing Methods, Region Split and Merge Method, Morphological Image Processing: Dilation, Erosion, Opening, Closing, Hit-or-Miss transformation, Object Recognition. Template Matching. Blob Analysis	10	CO4
V	Motion Analysis	Differential motion Analysis, Optical Flow, Analysis based on correspondence of interest points, Detection of specific motion Patterns, Video Tracking	04	CO5
VI	Emerging Trends in Machine Vision	History of Industrial Revolution(s), Machine Vision and Industry 4.0, Emerging Vision Trends in Manufacturing, 3D Imaging, Emerging Vision Trends in Manufacturing, Applications in Machine/ Computer Vision: Face detection, face recognition, eigen faces, car on roads	05	CO6



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Text Books:

1. Sheila Anand and L.Priya , —A Guide for Machine Vision in Quality Control, Taylor & Francis Inc, Imprint CRC Press Inc, Dec 2019
2. Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Pearson
3. Carsten Stegar, Markus Ulrich, and Christian Wiedemann , —Machine Vision Algorithms and Applications, Second completely Revised and Enlarged Edition
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, —Image Processing Analysis and Machine Vision, Second Edition, Cengage Learning.

References:

1. Chiranji Lal Chowdhary, Mamoun Alazab, Ankit Chaudhary, Saqib Hakak and Thippa Reddy Gadekallu , Computer Vision and Recognition Systems Using Machine and Deep Learning Approaches, Fundamentals, technologies and applications , IET COMPUTING SERIES 42
2. Joe Minichino Joseph Howse , Learning OpenCV 3 Computer Vision with Python, Second Edition, Packt Publishing Ltd.
3. Alexander Hornberg,, — Handbook of Machine and Computer Vision The Guide for Developers and Users,

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/108103174
4.	https://www.coursera.org/learn/introduction-computer-vision-watson-opencv
3.	https://www.udacity.com/course/introduction-to-computer-vision--ud810
4.	https://onlinecourses.nptel.ac.in/noc21_ee23/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC732	Quantum Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC732	Quantum Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the basic principles and concepts of quantum computing.
- 2 To explore the mathematical foundations essential for quantum computing.
- 3 To study the building blocks of quantum systems such as qubits and quantum gates.
- 4 To design and analyze simple quantum algorithms.
- 5 To understand the architecture and working principles of quantum hardware.
- 6 To explore software tools and platforms used for quantum programming and simulation.

Course Outcomes:

- 1 Understand basic concepts of quantum computing
- 2 Illustrate building blocks of quantum computing through architecture and programming models.
- 3 Appraise various mathematical models required for quantum computing
- 4 Discuss various quantum hardware building principles.
- 5 Identify the various quantum algorithms
- 6 Describe usage of tools for quantum computing.



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Prerequisite: Engineering Mathematics, Data Structures and Algorithm, Python Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Quantum Computing	Motivation for studying Quantum Computing Origin of Quantum Computing Quantum Computer vs. Classical Computer Introduction to Quantum mechanics Overview of major concepts in Quantum Computing Qubits and multi-qubits states Bloch Sphere representation Quantum Superposition Quantum Entanglement Major players in the industry (IBM, Microsoft, Rigetti, D-Wave etc.)	07	CO1
II	Mathematical Foundations for Quantum Computing	Matrix Algebra: basis vectors and orthogonality, inner product and Hilbert spaces, matrices and tensors, unitary operators and projectors, Dirac notation, Eigen values and Eigen vectors.	05	CO2



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III	Building Blocks for Quantum Program	Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubits States Quantum superposition of qubits (valid and invalid superposition) Quantum Entanglement Useful states from quantum algorithmic perceptive e.g. Bell State Operation on qubits: Measuring and transforming using gates. Quantum Logic gates and Circuit No Cloning Theorem and Teleportation Programming model for a Quantum Computing Program Steps performed on classical computer Steps performed on Quantum Computer Moving data between bits and qubits.	08	CO3
IV	Quantum Algorithms and Error correction	Quantum Algorithms, Shor's Algorithm, Grover's Algorithm. Deutsch's Algorithm, Deutsch - Jozsa Algorithm Quantum error correction using repetition codes 3 qubit codes, Shor's 9 qubit error correction Code	06	CO4



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V	Quantum Hardware	Ion Trap Qubits ,The DiVincenzo Criteria , Lagrangian and Hamiltonian Dynamics in a Nutshell: Dynamics of a Translating Rotor Quantum Mechanics of a Free Rotor: A Poor Person's Atomic Model: Rotor Dynamics and the Hadamard Gate, Two-Qubit Gates The Cirac-Zoller Mechanism: Quantum Theory of Simple Harmonic Motion, A Phonon-Qubit Pair Hamiltonian, Light- Induced Rotor-Phonon Interactions, Trapped Ion Qubits, Mølmer- Sørensen Coupling .. Cavity Quantum Electrodynamics (cQED): Eigenstates of the Jaynes-Cummings Hamiltonian Circuit QED (cirQED): Quantum LC Circuits, Artificial Atoms, Superconducting Qubits Quantum computing with spins: Quantum inverter realized with two exchange coupled spins in quantum dots, A 2-qubit spintronic universal quantum gate.	10	CO5
VI	OSS Toolkits for implementing Quantum program	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM)	03	CO6

Text Books:

1. Michael A. Nielsen, —Quantum Computation and Quantum Information, Cambridge University Press.
2. David McMahon, —Quantum Computing Explained, Wiley, 2008
3. Qiskit textbook <https://qiskit.org/textbook-beta/>
4. Vladimir Silva, Practical Quantum Computing for Developers, 2018



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References:

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
2. Supriyo Bandopadhyay and Marc Cahy, —Introduction to Spintronics, CRC Press, 2008
3. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4. La Guardia, Giuliano Gladioli —Quantum Error correction codes, Springer, 2021

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc21_cs103/preview
5.	https://www.coursera.org/courses?query=quantum%20computing
3.	https://www.cl.cam.ac.uk/teaching/1617/QuantComp/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC733	Natural Language Processing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem	Exam Duration			
		IAT-1	IAT-2	IAT-1 + IAT-2	Exam	(in Hrs)			
CMC733	Natural Language Processing	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To define natural language processing and to learn various stages of natural language processing.
- 2 To describe basic concepts and algorithmic description of the main language levels: Morphology, Syntax, Semantics, and Pragmatics & Discourse analysis.
- 3 To design and implement various language models and POS tagging techniques.
- 4 To design and learn NLP applications such as Information Extraction, Question answering.
- 5 To design and implement applications based on natural language processing.
- 6 To analyze the challenges and advancements in real-world NLP systems.



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Course Outcomes:

- 1 To describe the field of natural language processing.
- 2 To design language model for word level analysis for text processing.
- 3 To design various POS tagging techniques and parsers.
- 4 To design, implement and test algorithms for semantic and pragmatic analysis.
- 5 To formulate the discourse segmentation and anaphora resolution.
- 6 To apply NLP techniques to design real world NLP applications.

Prerequisite: Theory of Computer Science, System Programming & Compiler Construction

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to NLP	Origin & History of NLP; Language, Knowledge and Grammar in language processing; Stages in NLP; Ambiguities and its types in English and Indian Regional Languages; Challenges of NLP; Applications of NLP Self-Learning topics: Variety types of tools for regional languages pre-processing and other functionalities	03	CO1
II	Word Level Analysis	Basic Terms: Tokenization, Stemming, Lemmatization; Survey of English Morphology, Inflectional Morphology, Derivational Morphology; Regular expression with types; Morphological Models: Dictionary lookup, finite state morphology; Morphological parsing with FST (Finite State Transducer); Lexicon free FST Porter Stemmer algorithm; Grams and its variation: Bigram, Trigram; Simple (Unsmoothed) N-	09	CO2



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		grams; N-gram Sensitivity to the Training Corpus; Unknown Words: Open versus closed vocabulary tasks; Evaluating N-grams: Perplexity; Smoothing: Laplace Smoothing, Good-Turing Discounting; Self-Learning topics: Noisy channel models, various edit distance, Advance Issues in Language Modelling		
III	Syntax analysis	Part-Of-Speech tagging(POS); Tag set for English (Upenn Treebank); Difficulties /Challenges in POS tagging; Rule-based, Stochastic and Transformation-based tagging; Generative Model: Hidden Markov Model (HMM Viterbi) for POS tagging; Issues in HMM POS tagging; Discriminative Model: Maximum Entropy model, Conditional random Field (CRF); Parsers: Top down and Bottom up; Modelling constituency; Bottom Up Parser: CYK, PCFG (Probabilistic Context Free Grammar), Shift Reduce Parser; Top Down Parser: Early Parser, Predictive Parser Self-Learning topics: Evaluating parsers, Parsers based language modelling, Regional languages POS tree banks	10	CO3



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IV	Semantic Analysis	Introduction, meaning representation; Lexical Semantics; Corpus study; Study of Various language dictionaries like WorldNet, Babelnet; Relations among lexemes & their senses – Homonymy, Polysemy, Synonymy, Hyponymy; Semantic Ambiguity; Word Sense Disambiguation (WSD); Knowledge based approach (Lesk's Algorithm), Supervised (Naïve Bayes, Decision List), Introduction to Semi-supervised method (Yarowsky) Unsupervised (Hyperlex) Self-Learning topics: Dictionaries for regional languages, Distributional Semantics, Topic Models	07	CO4
V	Pragmatic & Discourse Processing	Discourse: Reference Resolution, Reference Phenomena, Syntactic & Semantic constraint on coherence; Anaphora Resolution using Hobbs and Canterling Algorithm Self-Learning topics: Discourse segmentation, Conference resolution	05	CO5
VI	Applications of NLP	Case studies on (preferable in regional language): Machine translation; Text Summarization; Sentiment analysis; Information retrieval; Question Answering system Self-Learning topics: Applications based on Deep Neural Network with NLP such as LSTM network, Recurrent Neural network etc.	05	CO6

Text Books:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Christopher D.Manning and HinrichSchutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.



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References:

1. Siddiqui and Tiwari U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
2. Daniel M Bikel and ImedZitouni — Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.
3. Alexander Clark, Chris Fox, Shalom Lappin — The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
4. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
5. Niel J le Roux and SugnetLubbe, A step by step tutorial: An introduction into R application and programming.
6. Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009.

Online References:

Sr. No.	Website Name
1.	http://www.cse.iitb.ac.in/~cs626-449
2.	http://cse24-iiith.virtual-labs.ac.in/#
3.	https://nptel.ac.in/courses/106105158



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC741	Augmented and Virtual Reality	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC741	Augmented and Virtual Reality	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To understand the need and significance of Virtual Reality.
- 2 To explore the concepts of Virtual reality and develop 3D virtual environments.
- 3 To understand the technical and engineering aspects of virtual reality systems.
- 4 To analyze various techniques for applying virtual reality.
- 5 To understand the integration of Virtual Reality with emerging technologies.
- 6 To provide a foundation in Augmented Reality and introduce various AR devices and platforms.

Course Outcomes:

- 1 Describe how VR systems work and list the applications of VR
- 2 Elaborate geometric presentation of the virtual world and its operations.
- 3 Explain the concepts of motion and tracking in VR systems.
- 4 Design and implementation of the hardware that enables VR systems to be built.



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- 5 Describe how AR systems work and analyze the hardware requirement of AR
- 6 Analyze and understand the working of various state of the art AR devices.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Virtual Reality	What is virtual reality? ,The beginnings of VR , VR paradigms Collaboration, Virtual reality systems, Representation ,User interaction	05	CO1
II	The Geometry of Virtual Worlds	Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations	06	CO2
III	Motion in Real and Virtual Worlds	Velocities and Accelerations, The Vestibular System, Physics in the Virtual World , Mismatched Motion and Vection	06	CO3
IV	Applying Virtual Reality	The Stream Data Model: A Data-Stream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing.	07	CO4
V	Augmented Reality	Terminology, Simple augmented reality, Augmented reality as an emerging technology, Augmented reality applications, Marker detection, Marker pose, Marker types and identification: Template markers, 2D bar-code markers, Imperceptible markers: Image markers, Infrared markers, Miniature markers, Discussion on marker use, General marker detection application	08	CO5



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VI	AR Development & Applications	User interfaces, Avoiding physical contacts, Practical experiences with head-mounted displays, Authoring and dynamic content, AR applications and future visions, How to design an AR application ,Technology adoption and acceptance , Where to use augmented reality		CO6

Text Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)ll. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig,William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality Sanni Siltanen

References:

1. AR Game Developmentll, 1st Edition, Allan Fowler, A press Publications, 2018, ISBN 978-1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016),ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi, O'Reilly Media, Inc., 2015, ISBN-9781491922835

Online References:

Sr. No.	Website Name
1.	https://freevidelectures.com/course/3693/virtual-reality
2.	https://www.vrlabacademy.com/
3.	https://arvr.google.com/ar/
4.	https://konterball.com/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC742	Blockchain	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC742	Blockchain	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 Understand the core concepts, platforms, and terminologies related to blockchain technology.
- 2 Explore the role of cryptography in ensuring security within blockchain systems.
- 3 Study the architecture and functionality of smart contracts and digital wallets.
- 4 Understand various consensus mechanisms used in blockchain networks.
- 5 Design and develop decentralized applications using blockchain technologies.
- 6 Analyze real-world use cases and challenges in blockchain adoption.

Course Outcomes:

- 1 Explain blockchain concepts.
- 2 Apply cryptographic hash required for blockchain.
- 3 Apply the concepts of smart contracts for an application.
- 4 Design a public blockchain using Ethereum.
- 5 Design a private blockchain using Hyperledger.
- 6 Use different types of tools for blockchain applications.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Blockchain	What is a blockchain, Origin of blockchain (cryptographically secure hash functions), Foundation of blockchain: Merkle trees Components of blockchain, Block in blockchain, Types: Public, Private, and Consortium, Consensus Protocol, Limitations and Challenges of blockchain	06	CO1
II	Cryptocurrency	Cryptocurrency: Bitcoin, Altcoin, and Tokens (Utility and Security), Cryptocurrency wallets: Hot and cold wallets, Cryptocurrency usage, Transactions in Blockchain, UTXO and double spending problem Bitcoin blockchain: Consensus in Bitcoin, Proof-of-Work (PoW), Proof-of-Burn (PoB), Proof-of-Stake (PoS), and Proof-of-Elapsed Time (PoET), Life of a miner, Mining difficulty, Mining pool and its methods	06	CO2



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III	Programming for Blockchain	Introduction to Smart Contracts, Types of Smart Contracts, Structure of a Smart Contract, Smart Contract Approaches, Limitations of Smart Contracts Introduction to Programming: Solidity Programming – Basics, functions, Visibility and Activity Qualifiers, Address and Address Payable, Bytes and Enums, Arrays-Fixed and Dynamic Arrays, Special Arrays-Bytes and strings, Struct, Mapping, Inheritance, Error handling Case Study – Voting Contract App, Preparing for smart contract development	08	CO3
IV	Public Blockchain	Introduction to Public Blockchain, Ethereum and its Components, Mining in Ethereum, Ethereum Virtual Machine (EVM), Transaction, Accounts, Architecture and Workflow, Comparison between Bitcoin and Ethereum Types of test-networks used in Ethereum, Transferring Ethers using Metamask, Mist Wallet, Ethereum frameworks, Case study of Ganache for Ethereum blockchain. Exploring etherscan.io and ether block structure	08	CO4



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V	Private Blockchain	Introduction, Key characteristics, Need of Private Blockchain, Smart Contract in a Private Environment, State Machine Replication, Consensus Algorithms for Private Blockchain - PAXOS and RAFT, Byzantine Faults: Byzantine Fault Tolerant (BFT) and Practical BFT Introduction to Hyperledger, Tools and Frameworks, Hyperledger Fabric, Comparison between Hyperledger Fabric & Other Technologies Hyperledger Fabric Architecture, Components of Hyperledger Fabric: MSP, Chain Codes, Transaction Flow, Working of Hyperledger Fabric, Creating Hyperledger Network, Case Study of Supply Chain Management using Hyperledger	08	CO5
VI	Tools and Applications of Blockchain	Corda, Ripple, Quorum and other Emerging Blockchain Platforms, Blockchain in DeFi: Case Study on any of the Blockchain Platforms.	04	CO6

Text Books:

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhillash K. A and Meena Karthikeyan, Universities Press.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr. Gavin Wood, O'reilly.
3. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing



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References:

1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3. Blockchain with Hyperledger Fabric, Luc Venkatraman Ramakrishna, Packt Publishing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC743	Information Retrieval	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
CMC743	Information Retrieval	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To learn the fundamentals of Information Retrieval
- 2 To analyze various Information retrieval modeling techniques
- 3 To understand query processing and its applications
- 4 To explore the various indexing and scoring techniques
- 5 To assess the various evaluation methods
- 6 To analyze various information retrieval for real world application

Course Outcomes:

- 1 Define and describe the basic concepts of the Information retrieval system.
- 2 Design the various modeling techniques for information retrieval systems.
- 3 Understand the query structure and various query operations
- 4 Analyzing the indexing and scoring operation in information retrieval systems
- 5 Perform the evaluation of information retrieval systems
- 6 Analyze various information retrieval for real world application



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Prerequisite: Data structures and algorithms.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Information Retrieval	Introduction to Information Retrieval, Basic Concepts, Information Versus Data, Trends and research issues in information retrieval. The retrieval process, Information retrieval in the library, web and digital libraries.	04	CO1
II	Modeling in Information Retrieval	Taxonomy of Information Retrieval models, Classic Information Retrieval, Alternate set: Theoretical model, Alternative Algebraic models, Alternative Probabilistic models Structured text Retrieval models, Models for browsing	08	CO2
III	Query and Operations in Information Retrieval	Query structures, Keyboard based querying, Pattern matching, Structured queries User relevance feedback, Automatic local analysis, Automatic global analysis	08	CO3



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IV	Indexing and Scoring in Information Systems	Introduction, Inverted Files, Other Indices for Text, Boolean queries and Introduction to Sequential searching Scoring, term weighting and the vector space model, Parametric and zone indexes, Weighted zone scoring, Learning weights, The optimal weight, Term frequency and weighting, Inverse document frequency, Tf-idf weighting. The vector space model for scoring, Queries as vectors, Computing vector scores, Efficient scoring and ranking, Inexact top K document retrieval	08	CO4
V	Evaluation of Information Retrieval Systems	Information retrieval system evaluation, Standard test collections, Evaluation of unranked retrieval sets, Evaluation of ranked retrieval results, Assessing and justifying the concept of relevance System quality and user utility, System issues, Refining a deployed system	06	CO5
VI	Applications of Information Retrieval Systems	Introduction to Multimedia Information Retrieval Introduction to Distributed Information Retrieval	05	CO6

Text Books:

1. Modern information retrieval, Baeza-Yates, R. and Ribeiro-Neto, B., 1999. ACM press.
2. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
3. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons



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References:

1. Storage Network Management and Retrieval, VaishaliKhairnar
2. Introduction to Modern Information Retrieval. G.G. Chowdhury. NealSchuman
3. Natural Language Processing and Information Retrieval by Tanveer Siddiqui, U.S Tiwarey

Online References:

Sr. No.	Website Name
1	https://web.stanford.edu/class/cs276/
2	https://www.coursera.org/learn/text-retrieval



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7501	Product Life Cycle Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7501	Product Life Cycle Management	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To familiarize students with the need, benefits, and key components of Product Lifecycle Management (PLM).
- 2 To acquaint students with Product Data Management (PDM) and PLM implementation strategies.
- 3 To provide insights into the processes involved in new product development.
- 4 To understand the guidelines and best practices for designing and developing new products.
- 5 To introduce students to the concept and tools of Virtual Product Development.
- 6 To explore the integration of PLM with modern engineering and manufacturing systems.



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Course Outcomes:

- 1 Describe the phases of Product Lifecycle Management (PLM), PLM strategies, and feasibility study methodologies.
- 2 Explain the implementation process of Product Data Management (PDM) within PLM systems.
- 3 Apply various approaches and techniques for product design and development.
- 4 Use product engineering guidelines and thumb rules for designing components in moulding, machining, and sheet metal processes.
- 5 Analyze design decisions for manufacturability and efficiency in product engineering.
- 6 Demonstrate the use of virtual product development tools for component design, machining simulation, and manufacturing plant layout.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	CO1
II	Product Design	Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models,	09	CO2



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		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		
III	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	CO3
IV	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	CO4
V	Integration of Environmental	Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies,	05	CO5



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	Aspects in Product Design	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		
VI	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	CO6

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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7502	Reliability Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7502	Reliability Engineering	20	20	40	60	2.5	--	--	100

Course 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 explain various types of reliability testing and data analysis techniques.
- 5 To cover the principles of Maintainability and Availability in system design.
- 6 To provide knowledge of Failure Modes and Effects Analysis (FMEA) and its application in reliability engineering.

Course Outcomes:

- 1 Understand and apply the concept of Probability to engineering problems
- 2 Apply probability theory to solve real-world engineering problems.
- 3 Explain key reliability concepts such as failure rate, MTTF, MTBF, and hazard rate.
- 4 Calculate reliability parameters for different types of systems and configurations.



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- 5 Estimate system reliability for both simple and complex systems using appropriate models.
- 6 Perform Failure Mode, Effects, and Criticality Analysis (FMECA) to assess system risk.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	CO1
II	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	CO2



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III	System Reliability	System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems	05	CO3
IV	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	CO4
V	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	CO5
VI	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	CO6

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. Conon, —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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7503	Management Information System	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7503	Management Information System	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the role and impact of Information Systems (IS) in organizations and society.
- 2 To understand data and knowledge management including BI, big data, data warehousing, and data marts.
- 3 To explore ethical, privacy, and security issues related to Information Systems.
- 4 To examine the role of Social Computing and its applications in e-commerce and customer relationship management.
- 5 To study computer networks, mobile computing, and cloud computing models relevant to business operations.
- 6 To understand the use of IS in organizational functions, ERP systems, and system development life cycle models.



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Course Outcomes:

- 1 Explain the importance of Information Systems and their impact on organizational strategy and society
- 2 Apply data and knowledge management techniques, including BI tools, for decision-making.
- 3 Identify security threats and describe ethical and privacy issues in Information Systems.
- 4 Analyze the use of Social Computing in marketing, CRM, and mobile commerce applications.
- 5 Differentiate between various computer network types and cloud computing models.
- 6 Design basic solutions using ERP systems and system development life cycle approaches.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	04	CO1
II	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	07	CO2
III	Ethical issues and Privacy	Information Security. Threat to IS, and Security Controls	07	CO3
IV	Social Computing (SC)	Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRME-business and E-commerce – B2B B2C. Mobile commerce.	07	CO4



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V	Computer Networks	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	06	CO5
VI	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.	08	CO6

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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7504	Design of Experiments	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7504	Design of Experiments	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the strategy of experimentation and its applications in engineering and scientific problems.
- 2 To understand the process of fitting regression models and performing diagnostic analysis.
- 3 To study the design and analysis of two-level and multi-level factorial experiments.
- 4 To explore fractional factorial designs and their relevance in reducing experimental runs.
- 5 To understand and apply response surface methodology for optimization of processes.
- 6 To introduce the Taguchi approach for robust parameter design and quality improvement.



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Course Outcomes:

- 1 Explain the strategy of experimentation and identify appropriate experimental designs for given applications.
- 2 Fit and analyze linear and multiple regression models, including hypothesis testing and prediction.
- 3 Design and evaluate full and fractional factorial experiments to study the effects of multiple factors.
- 4 Apply response surface methodology to optimize and interpret second-order experimental models.
- 5 Use center points, blocking, and split-plot designs to handle complex experimental conditions.
- 6 Analyze Taguchi designs using signal-to-noise ratios and recommend robust design improvements.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06	CO1
II	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	CO2
III	Two-Level Factorial Designs	The 2^2 Design The 2^3 Design The General 2^k Design	07	CO3



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		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		
IV	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	CO4
V	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	CO5
VI	Taguchi Approach	Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods Robust design examples	04	CO6

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



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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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7505	Operations Research	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7505	Operations Research	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the concepts, models, and scope of Operations Research in decision-making.
- 2 To study linear programming models, duality, sensitivity analysis, and their solution techniques.
- 3 To understand transportation, assignment, and integer programming problems with solution methodologies.
- 4 To explore queuing theory models and analyze single and multi-server systems.
- 5 To apply simulation techniques, including Monte Carlo methods, in decision-making scenarios.
- 6 To study dynamic programming, game theory, and inventory models for solving real-world optimization problems.

Course Outcomes:

- 1 Formulate and solve linear programming problems using graphical, simplex, and dual methods.
- 2 Apply appropriate methods to solve transportation, assignment, and integer



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- programming problems.
- 3 Analyze queuing models to evaluate system performance in different configurations.
 - 4 Demonstrate the use of simulation techniques such as the Monte Carlo method in system analysis.
 - 5 Apply dynamic programming methods to solve multi-stage decision problems.
 - 6 Evaluate inventory models and game theory strategies for decision-making in competitive and uncertain environments.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	14	CO1



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		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 Integer Programming Problem: Introduction, Types of Integer Programming Problems, Gomory's cutting plane Algorithm, Branch and Bound Technique. Introduction to Decomposition algorithms.		
II	Queuing models	Queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05	CO2
III	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	CO3
IV	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	CO4



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V	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	CO5
VI	Inventory Models	Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model	05	CO6

References:

1. Taha, H.A. "Operations Research - An Introduction", Prentice Hall, (7th Edition), 2002.
2. Ravindran, A, Phillips, D. T and Solberg, J. J. "Operations Research: Principles and Practice", John Wiley and Sons, 2nd Edition, 2009
3. Hiller, F. S. and Lieberman, G. J. "Introduction to Operations Research", Tata McGraw Hill, 2002.
4. Operations Research, S. D. Sharma, KedarNath Ram Nath-Meerut
5. Operations Research, Kanti Swarup, P. K. Gupta and Man Mohan, Sultan Chand & Sons



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7506	Cyber Security and Laws	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7506	Cyber Security and Laws	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the fundamental concepts, history, and global perspective of cybercrime.
- 2 To explore various cyber offenses and methods used by cybercriminals in different domains.
- 3 To examine tools, techniques, and attack vectors commonly employed in cybercrimes.
- 4 To understand the legal aspects of cyberspace, including contracts, security, intellectual property, and criminal law.
- 5 To study the provisions and amendments of the Indian IT Act, 2000 and 2008.
- 6 To provide an overview of major information security compliance standards and frameworks.



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Course Outcomes:

- 1 Define and explain various types of cybercrimes and their impact on information security.
- 2 Identify different cyber offense techniques and evaluate their implications on mobile and wireless devices.
- 3 Demonstrate the use of cybercrime tools and explain how common attacks such as phishing and SQL injection are performed.
- 4 Analyze the legal dimensions of cyberspace, including contracts, privacy, and intellectual property rights.
- 5 Interpret key sections of the Indian IT Act and assess its effectiveness in addressing cybercrimes.
- 6 Compare and apply information security standards such as SOX, HIPAA, and ISO in organizational contexts.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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.	04	CO1
II	Cyber offenses & Cybercrime	How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Botnets, 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	09	CO2



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		Mobile Computing Era, Laptops		
III	Tools and Methods Used in Cyberline	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)	06	CO3
IV	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	08	CO4
V	Indian IT Act.	Cyber Crime and Criminal Justice: Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	06	CO5
VI	Information Security Standard compliances	SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	06	CO6

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



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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>



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7507	Disaster Management and Mitigation Measures	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7507	Disaster Management and Mitigation Measures	20	20	40	60	2.5	--	--	100

Course 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



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Course Outcomes:

- 1 Define and explain the types, causes, and effects of natural and manmade disasters, including global warming and climate change.
- 2 Analyze the disaster management cycle, including policy, objectives, risks, and the paradigm shift in disaster response strategies.
- 3 Identify and evaluate the roles of institutions like NDMA and NIDM in disaster preparedness and response.
- 4 Apply technologies such as GIS, GPS, remote sensing, and internet-based tools for disaster management and communication.
- 5 Explain and assess financial mechanisms, legal frameworks, and the role of national and international relief agencies.
- 6 Design and propose structural and non-structural mitigation strategies including community preparedness, training, and awareness programs.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	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	CO1



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II	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	CO2
III	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	CO3



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IV	Institutional Framework for Disaster Management in India:	Importance of public awareness, Preparation and execution of emergency management program. 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. Use of Internet and softwares for effective disaster management. Applications of GIS, Remote sensing and GPS in this regard.	06	CO4
V	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	CO5



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VI	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	CO6

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.
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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7508	Energy Audit and Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7508	Energy Audit and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To introduce the present energy scenario and the need for energy conservation and efficient utilization.
- 2 To explain the principles of energy auditing, energy monitoring, and energy performance evaluation techniques.
- 3 To impart knowledge on financial analysis tools for assessing energy efficiency projects.
- 4 To familiarize students with energy conservation measures in electrical systems including lighting, motors, and drives.
- 5 To provide insights into energy conservation practices in thermal systems, HVAC, boilers, and insulation.
- 6 To create awareness of sustainable energy use in buildings through ECBC, LEED, and renewable energy integration.



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Course Outcomes:

- 1 Explain the current energy scenario, energy pricing, and energy conservation legislation such as the Energy Conservation Act-2001.
- 2 Apply principles of energy auditing and analyze energy usage using appropriate instruments and benchmarking techniques.
- 3 Evaluate energy efficiency projects using financial techniques like payback period, ROI, NPV, and IRR.
- 4 Demonstrate energy-saving measures in electrical systems such as lighting control, power factor correction, and use of energy-efficient appliances.
- 5 Analyze thermal system components including boilers, steam systems, and HVAC to identify potential energy conservation opportunities.
- 6 Design building energy systems considering ECBC compliance, green building principles, and renewable energy sources.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	CO1
II	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.	08	CO2



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		Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)		
III	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	CO3
IV	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	CO4
V	Energy Performance Assessment	On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations;	04	CO5



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		Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.		
VI	Energy conservation in Buildings	Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03	CO6

References:

1. Handbook of Electrical Installation Practice, Geofry Stokes, Blackwell Science
2. Designing with light: Lighting Handbook, By Anil Valia, Lighting System
3. Energy Management Handbook, By W.C. Turner, John Wiley and Sons
4. Handbook on Energy Audits and Management, edited by A. K. Tyagi, Tata Energy Research Institute (TERI).
5. Energy Management Principles, C.B.Smith, Pergamon Press
6. Energy Conservation Guidebook, Dale R. Patrick, S. Fardo, Ray E. Richardson, Fairmont Press
7. Handbook of Energy Audits, Albert Thumann, W. J. Younger, T. Niehus, CRC Press
8. www.energymanagertraining.com
9. www.bee-india.nic.in



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC7509	Development Engineering	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1 + IAT- 2					
OEC7509	Development Engineering	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To gain insight into the structure, characteristics, and dynamics of rural society in India and the scope of rural development.
- 2 To examine the nature, constraints, and challenges faced in the process of rural development planning and implementation.
- 3 To understand the impact and significance of the 73rd Constitutional Amendment Act on decentralized planning and rural governance.
- 4 To explore the integration of democratic processes into rural development strategies through Panchayati Raj Institutions.
- 5 To engage with the philosophical foundations of human values and their role in shaping personal, professional, and societal ethics.
- 6 To understand the relevance of human values and ethics in planning institutions and their influence on development-oriented decision-making.

Course Outcomes:

- 1 Apply knowledge for Rural Development.
- 2 Apply knowledge for Management Issues.
- 3 Apply knowledge for Initiatives and Strategies



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- 4 Develop acumen for higher education and research.
- 5 Master the art of working in group of different nature.
- 6 Develop confidence to take up rural project activities independently

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I		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	CO1
II		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	04	CO2
III		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 initiatives and their convergence; Special	06	CO3



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		component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development.		
IV		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	CO4
V		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	CO5
VI		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	CO6



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References:

1. ITPI, Village Planning and Rural Development, ITPI, New Delhi
2. Thooyavan, K.R. Human Settlements: A 2005 MA Publication, Chennai
3. GoI, Constitution (73rd GoI, 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
7. Weaver, R.C., The Urban Complex, Doubleday.
8. Farmer, W.P. et al, Ethics in Planning, American Planning Association, Washington.
9. How, E., Normative Ethics in Planning, Journal of Planning Literature, Vol.5, No.2, pp. 123-150.
10. Watson, V. , Conflicting Rationalities: -- Implications for Planning Theory and Ethics, Planning Theory and Practice, Vol. 4, No.4, pp.395 – 407



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R-2025- BE Computer Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML706	Machine Learning Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML706	Machine Learning Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To introduce foundational concepts and techniques of Machine Learning.
- 2 To implement core supervised learning algorithms such as Linear and Logistic Regression, and SVM.
- 3 To apply unsupervised learning techniques including DBSCAN and Graph-Based Clustering.
- 4 To gain hands-on experience with ensemble methods like Bagging and Boosting.
- 5 To implement dimensionality reduction methods such as PCA, SVD, and LDA.
- 6 To explore and construct decision trees using algorithms like CART.

Lab Outcomes:

- 1 To understand the fundamentals of regression techniques including Linear and Logistic Regression.



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- 2 To apply ensemble learning methods like Bagging and Boosting to improve prediction accuracy.
- 3 To analyze multivariate regression models and interpret relationships among multiple variables.
- 4 To implement advanced classification and dimensionality reduction techniques such as SVM, PCA, SVD, and LDA.
- 5 To evaluate clustering results using Graph-Based Clustering and DBSCAN for unsupervised learning.
- 6 To design decision tree models using CART and validate their performance on given datasets.

List of Experiments.

Sr No	List of Experiments	Hrs
01	To implement Linear Regression.	2
02	To implement Logistic Regression.	2
03	To implement Ensemble learning (bagging/boosting)	2
04	To implement multivariate Linear Regression.	2
05	To implement SVM	2
06	To implement PCA/SVD/LDA	2
07	To implement Graph Based Clustering	2
08	To implement DB Scan	2
09	To implement CART	2
10	To implement LDA	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2



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Text Books:

1. Peter Harrington, —Machine Learning in Action, DreamTech Press
2. Ethem Alpaydm, —Introduction to Machine Learning, MIT Press
3. Tom M. Mitchell, —Machine Learning, McGraw Hill
4. Stephen Marsland, —Machine Learning An Algorithmic Perspective, CRC Press

References:

1. Han Kamber, —Data Mining Concepts and Techniques, Morgan Kaufmann Publishers
2. Margaret. H. Dunham, —Data Mining Introductory and Advanced Topics, Pearson Education
3. Kevin P. Murphy, Machine Learning — A Probabilistic Perspective
4. Samir Roy and Chakraborty, —Introduction to soft computing, Pearson Edition.
5. Richard Duda, Peter Hart, David G. Stork, —Pattern Classification, Second Edition, Wiley Publications.

Online Resources:

Sr. No.	Website Name
1.	Data sets for Machine Learning algorithms: https://www.kaggle.com/datasets
2.	Machine Learning repository- https://archive.ics.uci.edu/ml/index.php
3.	Machine Learning from Coursera
4.	https://towardsdatascience.com/machine-learning/home
5.	https://onlinecourses.nptel.ac.in/noc21_cs85/preview

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML707	Big Data Analytics Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML707	Big Data Analytics Lab	--	--	--	--	25	25	50

Prerequisite: C Programming Language.

Lab Objectives:

- 1 Solve Big Data problems using Hadoop and MapReduce programming techniques
- 2 Apply Sqoop for data transfer between Hadoop and relational databases effectively.
- 3 Identify and execute commands on various NoSQL databases like MongoDB, Cassandra, and HBase.
- 4 Implement data stream algorithms for real-time data analysis.
- 5 Perform analytics and visualization using Hive, PIG, R, or Tableau tools.
- 6 Design and develop mini-projects using Spark, Flume, and real-time datasets for practical big data applications.

Lab Outcomes:

- 1 To interpret business models and scientific computing paradigms, and apply software tools for big data analytics.



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- 2 To implement algorithms that uses Map Reduce to apply on structured and unstructured data
- 3 To perform data operations using NoSQL databases like MongoDB, Cassandra, and HBase.
- 4 To apply data stream algorithms such as DGIM, Bloom Filter, and Flajolet-Martin in real-time analytics.
- 5 To develop and visualize social network graphs using tools like R and Tableau.
- 6 To analyze large-scale spatio-temporal data using Spark/PySpark for exploratory insights and recommendations.

List of Experiments.

Sr No	List of Experiments	Hrs
(Select a case study and perform the experiments 1 to 8.).		
Star (*) marked experiments are compulsory.		
1*	Hadoop HDFS Practical: HDFS Basics, Hadoop Ecosystem Tools Overview. -Installing Hadoop. -Copying File to Hadoop. -Copy from Hadoop File system and deleting file. -Moving and displaying files in HDFS. -Programming exercises on Hadoop	2
2	Use of Sqoop tool to transfer data between Hadoop and relational database servers. a. Sqoop - Installation. b. To execute basic commands of Hadoop eco system component Sqoop.	2
3*	To install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL commands	2
4	Experiment on Hadoop Map-Reduce: -Write a program to implement a word count program using MapReduce.	2
5	Experiment on Hadoop Map-Reduce: -Implementing simple algorithms in Map-Reduce: Matrix multiplication, Aggregates, Joins, Sorting, Searching, etc	2
6	Create HIVE Database and Descriptive analytics-basic statistics.	2
7*	Data Stream Algorithms (any one): -Implementing DGIM algorithm using any Programming Language	2



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	Implement Bloom Filter using any programming language	
	Implement Flajolet Martin algorithm using any programming language	
8	Social Network Analysis using R (for example: Community Detection Algorithm)	2
9	Data Visualization using Hive/PIG/R/Tableau/.	2
10	Exploratory Data Analysis using Spark/ Pyspark.	2
11*	Mini Project: One real life large data application to be implemented (Use standard Datasets available on the web). - Streaming data analysis – use flume for data capture, HIVE/PYSpark for analysis of twitter data, chat data, weblog analysis etc. - Recommendation System (for example: Health Care System, Stock Market Prediction, Movie Recommendation, etc.) - Spatio Temporal Data Analytics	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Cre Anand Rajaraman and Jeff Ullman —Mining of Massive Datasets, Cambridge University Press
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan Mcary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.
4. DT Editorial Services, —Big Data Black Book, Dream tech Press
5. EMC Education Services, Data Science and Big Data Analytics, Wiley

References:

1. Bill Franks , —Taming The Big Data Tidal Wave: Finding Opportunities In Huge Data Streams With Advanced Analytics, Wiley
2. Chuck Lam, —Hadoop in Action, Dreamtech Press
3. Jared Dean, —Big Data, Data Mining, and Machine Learning: Value Creation for Business Leaders and Practitioners, Wiley India Private Limited, 2014.



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4. Jiawei Han and Micheline Kamber, —Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd ed, 2010.
5. Lior Rokach and Oded Maimon, —Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010.
6. Ronen Feldman and James Sanger, —The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
7. Vojislav Kecman, —Learning and Soft Computing, MIT Press, 2010.

Online Resources:

Sr. No.	Website Name
1.	https://www.coursera.org/learn/hadoop#syllabus
2.	https://www.coursera.org/learn/introduction-mongodb#syllabus
3.	https://www.coursera.org/learn/data-visualization-tableau?specialization=data-visualization#syllabus
4.	https://www.coursera.org/learn/introduction-to-big-data-with-spark-hadoop#syllabus

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML781	Machine Vision Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML781	Machine Vision Lab	--	--	--	--	25	25	50

Prerequisite: Computer Graphics, Image Processing, Python

Lab Objectives:

- 1 To perform basic image processing operations
- 2 To explore different preprocessing technique
- 3 To develop application related to Machine vision
- 4 To detect and recognize objects
- 5 To implement and evaluate segmentation and depth estimation techniques
- 6 To apply computer vision algorithms for real-time image/video analytics

Lab Outcomes:

- 1 Students will be able to identify and perform basic image and video file operations.
- 2 Students will apply preprocessing techniques like color space conversion and filtering.
- 3 Students will analyze and perform edge and contour detection.
- 4 Students will estimate depth using disparity maps and camera feeds.



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- 5 Students will choose and implement suitable segmentation and object detection methods.
- 6 Students will build and test models for face and object recognition using feature extraction.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Handling Files, Cameras, and GUIs Basic I/O scripts ,Reading/writing an image file ,Converting between an image and raw bytes ,Accessing image data with numpy. array ,Reading/writing a video file ,Capturing camera frames, Displaying images in a window, Displaying camera frames in a window	2
02	Processing Images with OpenCV 3 Converting between different color spaces, The Fourier Transform, High pass filter, Low pass filter,	2
03	Edge detection with Canny, Contour detection, Contours – bounding box, minimum area rectangle, and minimum enclosing circle, Contours – convex contours and the Douglas-Peucker algorithm ,Line and circle detection	2
04	Depth Estimation Capturing frames from a depth camera Creating a mask from a disparity map Masking a copy operation Depth estimation with a normal camera	2
05	Object segmentation using the Watershed and GrabCut algorithms Example of foreground detection with GrabCut Image segmentation with the Watershed algorithm	2
06	Detecting and Recognizing Faces Conceptualizing Haar cascades Getting Haar cascade data Using OpenCV to perform face detection Performing face detection on a still image	2
07	Performing face detection on video Performing face recognition Generating the data for face recognition Recognizing faces Preparing the training data Loading the data and recognizing faces Performing an Eigenfaces recognition	2
08	Retrieving Images and Searching Using Image Descriptors , Feature detection algorithms, Defining features	2



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	Detecting features – corners Feature extraction and description using DoG and SIFT Anatomy of a keypoint	
09	Detecting and Recognizing Objects Object detection and recognition techniques HOG descriptors The scale issue The location issue Non-maximum (or non-maxima) suppression Support vector machines People detection	2
10	Creating and training an object detector Bag-of-words BOW in computer vision Detecting cars in a scene	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Sheila Anand and L.Priya , —A Guide for Machine Vision in Quality Controll, Taylor & Francis Inc, Imprint CRC Press Inc, Dec 2019
2. Rafael C. Gonzalez and Richard E. Woods, —Digital Image Processing, Pearson
3. Carsten Stegar, Markus Ulrich, and Christian Wiedemann , —Machine Vision Algorithms and Applications, Second completely Revised and Enlarged Edition
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, —Image Processing Analysis and Machine Vision, Second Edition, Cengage Learning.

References:

1. Chiranji Lal Chowdhary, Mamoun Alazab, Ankit Chaudhary, SaqibHakak and Thippa Reddy Gadekallu , Computer Vision and Recognition Systems Using Machine and Deep Learning Approaches, Fundamentals, technologies and applications, IET COMPUTING SERIES 42



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2. Joe Minichino Joseph Howse ,||Learning OpenCV 3 Computer Vision with Python||, Second Edition, Packt Publishing Ltd.
3. Alexander Hornberg,, — Handbook of Machine and Computer Vision The Guide for Developers and Users,

Online Resources:

Sr. No.	Website Name
1.	Learning OpenCV 3 Computer Vision with Python Second Edition, by Joe Minichino Joseph Howse Published by Packt Publishing Ltd.
2.	http://iitk.ac.in/ee/computer-vision-lab
3.	https://nptel.ac.in/courses/108103174
4.	https://docs.opencv.org/3.4/d9/df8/tutorial_root.html

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML782	Quantum Computing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practica / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML782	Quantum Computing Lab	--	--	--	--	25	25	50

Prerequisite: Python Programming Language.

Lab Objectives:

- 1 To implement fundamental quantum computing concepts
- 2 To learn quantum computation and quantum information
- 3 To understand quantum entanglement, quantum algorithms
- 4 To understand quantum information theory and channels
- 5 To analyze entanglement using Bell and GHZ circuits.
- 6 To apply quantum computing concepts through mini-projects.

Lab Outcomes:

- 1 Implement basic quantum computing logic by building dice and random numbers using open source simulation tools.
- 2 Understand quantum logic gates using open source simulation tools.
- 3 Implement quantum circuits using open source simulation tools.



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- 4 Implement quantum algorithms using open source simulation tools.
- 5 Analyze quantum entanglement through Bell and GHZ circuits.
- 6 Design and develop a mini-project using quantum algorithms for real-world problems.

List of Experiments.

Sr No	List of Experiments	Hrs
1	Building Quantum dice	2
2	Building Quantum Random No. Generation	2
3	Composing simple quantum circuits with q-gates and measuring the output into classical bits.	2
4	Implementation of Shor's Algorithms	2
5	Implementation of Grover's Algorithm	2
6	Implementation of Deutsch's Algorithm	2
7	Implementation of Deutsch-Jozsa's Algorithm	2
8	Quantum Circuits	2
9	Qubit Gates	2
10	Bell Circuit & GHZ Circuit	2
11	Accuracy of Quantum Phase Estimation	2
12	Mini Project such as implementing an API for efficient search using Grover's Algorithms or Integer factorization using Shor's Algorithm.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2



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Text Books:

1. Michael A. Nielsen, —Quantum Computation and Quantum Information, Cambridge University Press.
2. David McMahon, —Quantum Computing Explained, Wiley, 2008
3. Qiskit textbook <https://qiskit.org/textbook-beta/>
4. Vladimir Silva, Practical Quantum Computing for Developers, 2018

References:

1. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
2. Supriyo Bandopadhyay and Marc Cahy, —Introduction to Spintronics, CRC Press, 2008
3. The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
4. La Guardia, Giuliano Gladioli —Quantum Error correction codes, Springer, 2021

Online Resources:

Sr. No.	Website Name
1.	IBM Experience: https://quantum-computing.ibm.com/
2.	Microsoft Quantum Development Kit https://azure.microsoft.com/en-us/resources/development-kit/quantum-computing/#overview
3.	Forest SDK PyQuil: https://pyquil-docs.rigetti.com/en/stable/
4.	Google Quantum CIRQ https://quantumai.google/cirq
5.	Qiskit Labs IBM https://learn.qiskit.org/course/ch-labs/lab-1-quantum-circuits



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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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML783	Natural Language processing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML783	Natural Language processing Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To understand the key concepts of NLP.
- 2 To learn various phases of NLP.
- 3 To design and implement various language models and POS tagging techniques.
- 4 To understand various NLP Algorithms
- 5 To learn NLP applications such as Information Extraction, Sentiment Analysis, Question answering, Machine translation etc.
- 6 To design and implement applications based on natural language processing

Lab Outcomes:

- 1 Apply various text processing techniques.
- 2 Design language model for word level analysis.
- 3 Model linguistic phenomena with formal grammar.
- 4 Design, implement and analyze NLP algorithms.
- 5 To apply NLP techniques to design real world NLP applications such as machine translation, sentiment analysis, text summarization, information extraction, Question Answering system etc.
- 6 Implement proper experimental methodology for training and evaluating empirical NLP systems.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study various applications of NLP and Formulate the Problem Statement for Mini Project based on chosen real world NLP applications: [Machine Translation, Text Categorization, Text summarization, chat Bot, Plagiarism, Spelling & Grammar checkers, Sentiment / opinion analysis, Question answering, Personal Assistant, Tutoring Systems, etc.]	2
02	Apply various text preprocessing techniques for any given text : Tokenization and Filtration & Script Validation.	2
03	Apply various other text preprocessing techniques for any given text : Stop Word Removal, Lemmatization / Stemming.	2
04	Perform morphological analysis and word generation for any given text.	2
05	Implement N-Gram model for the given text input.	2
06	Study the different POS taggers and Perform POS tagging on the given text.	2
07	Perform Chunking for the given text input.	2
08	Implement Named Entity Recognizer for the given text input.	2
09	Implement Text Similarity Recognizer for the chosen text documents.	2
10	Exploratory data analysis of a given text (Word Cloud)	2



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11	Mini Project Report: For any one chosen real world NLP application.	2
12	Implementation and Presentation of Mini Project	2

Term Work:

1	Study various applications of NLP and Formulate the Problem Statement for Mini Project based on chosen real world NLP applications: [Machine Translation, Text Categorization, Text summarization, chat Bot, Plagiarism, Spelling & Grammar checkers, Sentiment / opinion analysis, Question answering, Personal Assistant, Tutoring Systems, etc.]
2	Apply various text preprocessing techniques for any given text: Tokenization and Filtration & Script Validation.
3	Apply various other text preprocessing techniques for any given text: Stop Word Removal, Lemmatization / Stemming.

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Daniel Jurafsky, James H. and Martin, Speech and Language Processing, Second Edition, Prentice Hall, 2008.
2. Christopher D. Manning and Hinrich Schutze, Foundations of Statistical Natural Language Processing, MIT Press, 1999.

References:

1. Siddiqui and Tiwary U.S., Natural Language Processing and Information Retrieval, Oxford University Press, 2008.
2. Daniel M Bikel and Imed Zitouni — Multilingual natural language processing applications: from theory to practice, IBM Press, 2013.



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3. Alexander Clark, Chris Fox, Shalom Lappin — The Handbook of Computational Linguistics and Natural Language Processing, John Wiley and Sons, 2012.
4. Nitin Indurkha and Fred J. Damerau, —Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
5. Niel J le Roux and SugnetLubbe, A step by step tutorial: An introduction into R application and programming.
Steven Bird, Ewan Klein and Edward Loper, Natural language processing with Python: analyzing text with the natural language toolkit, O'Reilly Media, 2009.

Online Resources:

Sr. No.	Website Name
1.	http://www.cse.iitb.ac.in/~cs626-449
2.	http://cse24-iiith.virtual-labs.ac.in/#
3.	https://nptel.ac.in/courses/106105158

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML791	Augmented and Virtual Reality Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML791	Augmented and Virtual Reality Lab	--	--	--	--	25	25	50

Prerequisite: Data Structures, Analysis of Algorithms

Lab Objectives:

- 1 To perform installation of Unity
- 2 To explore working of VR Gadget
- 3 To develop scene VR application
- 4 Apply transformations, materials, and textures to 3D objects in a VR scene.
- 5 Implement interaction and control of objects in VR using C# scripts and controllers.
- 6 Integrate AR features such as AR plane detection and Augmented Faces into applications.

Lab Outcomes:

- 1 Students will set up Unity and Visual Studio for VR development.
- 2 Students will operate VR devices like HTC Vive and Google Cardboard.



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- 3 Students will develop interactive 3D scenes in Unity with basic objects.
- 4 Students will write C# scripts to manipulate materials and object behavior.
- 5 Students will design UI elements and implement VR-based interactions.
- 6 Students will integrate ARCore features including augmented faces and surface tracking.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Installation of Unity and Visual Studio, setting up Unity for VR development, understanding documentation of the same.	2
02	Demonstration of the working of HTC Vive, Google Cardboard, Google Daydream and Samsung gear VR.	2
03	Develop a scene in Unity that includes: i. a cube, plane and sphere, apply transformations on the 3 game objects. ii. add a video and audio source	2
04	Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene. Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click.	2
05	Develop a scene in Unity that includes a sphere and plane . Apply Rigid body component, material and Box collider to the game Objects. Write a C# program to grab and throw the sphere using vr controller.	2
06	Develop a simple UI(User interface) menu with images, canvas, sprites and button. Write a C# program to interact with UI menu through VR trigger button such that on each successful trigger interaction display a score on scene .	2
07	Place a three-dimensional ARCore pawn on detected AR plane surfaces	2
08	Using the Augmented Faces feature in your own apps.	2



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Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)l. Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
4. Theory and applications of marker-based augmented reality Sanni Siltanen

References:

1. AR Game Developmentl, 1st Edition, Allan Fowler, A press Publications, 2018, ISBN 978- 1484236178
2. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494
3. Learning Virtual Reality, Tony Parisi, O'Reilly Media, Inc., 2015, ISBN- 9781491922835

Online Resources:

Sr. No.	Website Name
1.	https://freevideolectures.com/course/3693/virtual-reality
2.	https://www.vrlabacademy.com/
3.	https://arvr.google.com/ar/
4.	https://konterball.com/



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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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML792	Blockchain Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML791	Blockchain Lab	--	--	--	--	25	25	50

Prerequisite: Cryptography and Network Security

Lab Objectives:

- 1 Understand the fundamental concepts of blockchain and its architecture.
- 2 Explore cryptographic techniques like Merkle tree hashing.
- 3 Develop and deploy smart contracts using Solidity.
- 4 Work with blockchain platforms like Ethereum, Geth, and Ganache.
- 5 Integrate wallets and transactions in decentralized applications.
- 6 Analyze blockchain use cases and create a basic blockchain application.

Lab Outcomes:

- 1 Identify and generate cryptographic hashes using Merkle tree concepts.
- 2 Design and deploy smart contracts using Solidity and Remix IDE.
- 3 Construct blockchain transactions and manage wallets using Solidity.
- 4 Implement Ethereum blockchain using Geth for decentralized applications.
- 5 Compare features of blockchain platforms such as Ganache and Hyperledger through case studies.
- 6 Develop a basic real-world blockchain application demonstrating key blockchain principles.



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List of Experiments.

Sr No	List of Experiments	Hrs
1	Cryptography in Blockchain, Merkle root tree hash	2
2	Creating Smart Contract using Solidity and Remix IDE.	2
3	Creating Transactions using Solidity and Remix IDE	2
4	Embedding wallet and transaction using Solidity	2
5	Blockchain platform ethereum using Geth.	2
6	Blockchain platform Ganache.	2
7	Case Study on Hyperledger	2
8	Case Study on Other Blockchain platforms.	2
9	Creating a blockchain Application	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Blockchain Technology, Chandramouli Subramanian, Asha A. George, Abhillash K. A and Meena Karthikeyan, Universities Press.
2. Mastering Ethereum, Building Smart Contract and Dapps, Andreas M. Antonopoulos Dr.Gavin Wood, O'reilly.
3. Imran Bashir, Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more, 3rd Edition, Packt Publishing



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References:

1. Blockchain for Beginners, Yathish R and Tejaswini N, SPD
2. Blockchain Basics, A non Technical Introduction in 25 Steps, Daniel Drescher, Apress.
3. Blockchain with Hyperledger Fabric, Luc Venkatraman Ramakrishna, Packt Publishing

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.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CML793	Information Retrieval Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	IAT 1 + IAT 2				
CML793	Information Retrieval Lab	--	--	--	--	25	25	50

Prerequisite: Java, Python

Lab Objectives:

- 1 Understand the process of query formation and execution.
- 2 Implement various information retrieval modeling techniques.
- 3 Apply pattern matching and indexing methods.
- 4 Explore and apply query expansion techniques.
- 5 Perform system evaluation for IR effectiveness.
- 6 Analyze real-world case studies related to IR systems.

Lab Outcomes:

- 1 Formulate and execute structured queries for information retrieval.
- 2 Implement various IR modeling techniques such as vector space or probabilistic models.
- 3 Apply pattern matching and query expansion methods to enhance search results.



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- 4 Construct inverted index and apply tf-idf weighting for document ranking.
- 5 Evaluate the effectiveness of IR systems using standard evaluation metrics.
- 6 Analyze case studies and generate technical reports related to information retrieval systems.

List of Experiments.

Sr No	List of Experiments	Hrs
1	To understand the query structure and execute various structured queries	2
2	To implement any IR modeling technique	2
3	To implement Pattern matching method used for IR	2
4	To execute query expansion technique (Local/Global)	2
05	To design inverted indices for any information retrieval model	2
06	To implement tf-id weighting	2
07	To evaluate the system/application under study	2
08	To understand the Case Study and generate a report for the same	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment covers the topics from first three units. Limited to three questions.	2
02	Assignment covers the topics from last three units. Limited to three questions.	2

Text Books:

1. Modern information retrieval, Baeza-Yates, R. and Ribeiro-Neto, B., 1999. ACM press.
2. Introduction to Information Retrieval By Christopher D. Manning and Prabhakar Raghavan, Cambridge University Press
3. Information Storage & Retrieval By Robert Korfhage – John Wiley & Sons



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Online Resources:

Sr. No.	Website Name
1.	https://web.stanford.edu/class/cs276/
2.	https://www.coursera.org/learn/text-retrieval

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.



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Course Code	Course Name	Credit
CML710	Major Project 1	02

Course Objectives:

- 1 To enable students to identify, define, and analyze real-world engineering problems through systematic literature review and stakeholder consultation.
- 2 To develop and apply appropriate engineering knowledge, tools, and technologies for designing feasible and efficient solutions to identified problems..
- 3 To promote teamwork and collaborative project management skills through effective planning, task delegation, and communication within multidisciplinary teams.
- 4 To encourage the integration of professional ethics, social responsibility, and sustainability principles in engineering project design and implementation.
- 5 To strengthen written and oral communication skills through documentation, presentations, and technical reporting of the project work.
- 6 To foster independent learning, critical thinking, and lifelong learning aptitude through iterative problem-solving and self-evaluation during the project lifecycle.

Course Outcomes: Learner will able

- 1 To develop the understanding of the problem domain through extensive review of literature.
- 2 To Identify and analyze the problem in detail to define its scope with problem specific data.
- 3 To know various techniques to be implemented for the selected problem and related technical skills through feasibility analysis.
- 4 To design solutions for real-time problems that will positively impact society and environment..
- 5 To develop clarity of presentation based on communication, teamwork and leadership skills.
- 6 To inculcate professional and ethical behavior.



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Guidelines:

1. Project Topic Selection and Allocation:

- Project topic selection Process to be defined and followed:
 - Project orientation can be given at the end of sixth semester.
 - Students should be informed about the domain and domain experts whose guidance can be taken before selecting projects.
 - Student's should be recommended to refer papers from reputed conferences/ journals like IEEE, Elsevier, ACM etc. which are not more than 3 years old for review of literature.
 - Students can certainly take ideas from anywhere, but be sure that they should evolve them in the unique way to suit their project requirements. Students can be informed to refer Digital India portal, SIH portal or any other hackathon portal for problem selection.
- Topics can be finalized with respect to following criterion:
 - **Topic Selection:** The topics selected should be novel in nature (Product based, Application based or Research based) or should work towards removing the lacuna in currently existing systems.
 - **Technology Used:** Use of latest technology or modern tools can be encouraged.
 - Students should not repeat work done previously (work done in the last three years).
 - Project work must be carried out by the group of at least 2 students and maximum 4.
 - The project work can be undertaken in a research institute or organization/Industry/any business establishment. (out-house projects)
 - The project proposal presentations can be scheduled according to the domains and should be judged by faculty who are expert in the domain.
 - Head of department and senior staff along with project coordinators will take decision regarding final selection of projects.
 - Guide allocation should be done and students have to submit weekly progress report to the internal guide.
 - Internal guide has to keep track of the progress of the project and also has to maintain attendance report. This progress report can be used for awarding term work marks.
 - In case of industry/ out-house projects, visit by internal guide will be preferred and external members can be called during the presentation at various levels



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2. Project Report Format:

At the end of semester, each group needs to prepare a project report as per the guidelines issued by the University of Mumbai.

A project report should preferably contain at least following details:

- Abstract
- Introduction
- Literature Survey/ Existing system
- Limitation Existing system or research gap
- Problem Statement and Objective
- Proposed System
 - Analysis/Framework/ Algorithm
 - Design details
 - Methodology (your approach to solve the problem) Proposed System
- Experimental Set up
 - Details of Database or details about input to systems or selected data
 - Performance Evaluation Parameters (for Validation)
 - Software and Hardware Set up
- Implementation Plan for Next Semester
- Timeline Chart for Term-I and Term-II (Project Management tools can be used.)
- References

Desirable

Students can be asked to undergo some Certification course (for the technical skill set that will be useful and applicable for projects.)



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Semester-VIII



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC801	Distributed Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
CMC801	Distributed Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide students with contemporary knowledge in distributed systems.
2. To explore the various methods used for communication in distributed systems.
3. To provide skills to measure the performance of distributed synchronization algorithms.
4. To provide knowledge of resource management, and process management including process migration.
5. To learn issues involved in replication, consistency, and file management.
6. To equip students with skills to analyze and design distributed applications.

Course Outcomes:

1. Demonstrate the knowledge of basic elements and concepts related to distributed system



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technologies.

2. Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object-based middleware.
3. Analyze the various techniques used for clock synchronization, mutual exclusion and deadlock.
4. Demonstrate the concepts of Resource and Process management.
5. Demonstrate the concepts of Consistency, Replication Management and fault Tolerance.
6. Apply the knowledge of Distributed File systems in building large-scale distributed applications

Prerequisite: Computer Networks and Operating System.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Distributed Systems	Characterization of Distributed Systems: Issues, Goals, Types of distributed systems, Grid and Cluster computing Models, Hardware and Software Concepts: NOS, DOS. Middleware: Models of middleware, Services offered by middleware.	4	CO1
II	Communication Interprocess communication (IPC)	Remote Procedure Call (RPC), Remote, Method Invocation (RMI). Message-Oriented Communication, Stream Oriented Communication, Group Communication.	4	CO2



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III	Synchronization Clock	Clock Synchronization: Physical clock, Logical Clocks, Election Algorithms Distributed Mutual Exclusion, Requirements of Mutual Exclusion Algorithms and Performance measures. Non- token Based Algorithms: Lamport, Ricart-Agrawala_s and Maekawa_s Algorithms; Token-based Algorithms: Suzuki-Kasami_s Broadcast Algorithms and Raymond_s Tree-based Algorithm; and Comparative Performance Analysis. Deadlock: Introduction, Deadlock Detection: Centralized approach, Chandy - Misra_Hass Algorithm.	10	CO3
IV	Resource and Process Management	Desirable Features of Global Scheduling algorithm, Task assignment approach, Load balancing approach and load sharing approach. Introduction to Process Management, Process Migration, Code Migration.	7	CO4



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V	Replication, Consistency and Fault Tolerance	Distributed Shared Memory: Architecture, design issues. Introduction to replication and consistency, Data-Centric and Client-Centric Consistency Models, Replica Management. Fault Tolerance: Introduction, Process resilience, Recovery.	8	CO5
VI	Distributed File Systems	Introduction and features of DFS, File models, File Accessing models, File-Caching Schemes, File Replication, Case Study: Network File System (NFS). Designing Distributed Systems: Google Case Study.	6	CO6

Text Books:

1. A.S. Tanenbaum & M. van Steen, Distributed Systems: Principles and Paradigms, Pearson
2. M. Singhal & N.G. Shivaratri, Advanced Concepts in Operating Systems, McGraw-Hill
3. P.K. Sinha, Distributed Operating Systems, PHI

References:

1. M.L. Liu, Distributed Computing Principles and Applications, Pearson
2. G. Coulouris et al., Distributed Systems: Concepts and Design, Pearson



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106107
2.	http://csis.pace.edu/~marchese/CS865/Lectures/Chap7/Chapter7fin.htm
3.	https://nptel.ac.in/courses/106106168



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC821	Deep Learning	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IA T-1	IAT-2	IAT- 1+IAT -2					
CMC821	Deep Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the fundamental concepts and architecture of Neural Networks.
2. To learn various activation functions, loss functions, and optimization techniques used in Deep Learning.
3. To gain hands-on experience in training and evaluating Deep Neural Networks.
4. To explore advanced Deep Learning models such as Convolutional Neural Networks (CNNs).
5. To study specialized architectures including Autoencoders and Recurrent Neural Networks (RNNs).
6. To become familiar with recent trends, applications, and research directions in the field of Deep Learning.



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Course Outcomes:

1. Understand the basic concepts and working principles of Neural Networks.
2. Demonstrate in-depth understanding of training techniques for Deep Neural Networks.
3. Apply suitable activation functions, loss functions, and optimizers for different learning tasks.
4. Design Deep Neural Network models for supervised learning problems.
5. Develop models using Autoencoders and Recurrent Neural Networks for unsupervised and sequence learning tasks.
6. Analyze and explore recent trends and real-world applications of Deep Learning.

Prerequisite: Basic mathematics and Statistical concepts, Linear algebra, Machine Learning

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Fundamentals of Neural Network	Biological neuron, McCulloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly non-separable classes Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning	4	CO1



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II	Training, Optimization and Regularization of Deep Neural Network	Training Feedforward DNN Multi Layered Feed Forward Neural Network, Learning Factors, Activation functions: Tanh, Logistic, Linear, Softmax, ReLU, Leaky ReLU, Loss functions: Squared Error loss, Cross Entropy, Choosing output function and loss function Optimization Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp Regularization Overview of Overfitting, Types of biases, Bias Variance Tradeoff Regularization Methods: L1, L2 regularization, Parameter sharing, Dropout, Weight Decay, Batch normalization, Early stopping, Data Augmentation, Adding noise to input and output	10	CO2



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III	Autoencoders: Unsupervised Learning	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders Application of Autoencoders: Image Compression	6	CO3
IV	Convolutional Neural Networks (CNN):	Convolution operation, Padding, Stride, Relation between input, output and	4	CO4



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	Supervised Learning	filter size, CNN architecture: Convolution layer, Pooling Layer, Weight Sharing in CNN, Fully Connected NN vs CNN, Variants of basic Convolution function Modern Deep Learning Architectures: LeNET: Architecture, AlexNET: Architecture		
V	Recurrent Neural Networks (RNN)	Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Backpropagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit	8	CO5
VI	Recent Trends and Applications	Generative Adversarial Network (GAN): Architecture Applications: Image Generation, DeepFake	4	CO6



Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville. —Deep Learning, MIT Press Ltd, 2016 Li Deng and Dong Yu, —Deep Learning Methods and Applications, Publishers Inc.
2. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
3. JM Zurada —Introduction to Artificial Neural Systems, Jaico Publishing House
4. M. J. Kochenderfer, Tim A. Wheeler. —Algorithms for Optimization, MIT Press.

References:

1. Buduma, N. and Locascio, N., —Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc."
2. François Chollet. —Deep learning with Python —(Vol. 361). 2018 New York: Manning.
3. Douwe Osinga. —Deep Learning Cookbook, O'REILLY, SPD Publishers, Delhi.
4. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc
5. S.N.Sivanandam and S.N.Deepa, Principles of soft computing-Wiley Indi

Online References:

Sr. No.	Website Name
1	https://nptel.ac HYPERLINK " https://nptel.ac.in/courses/106/105/106105175/ ". https://deeplearning.cs.cmu.edu/S21/index.html
2	http://www.cse.iitm.ac.in/~miteshk/CS6910.html
3	https://nptel.ac.in/courses/106/106/106106184/
4	https://www.deeplearningbook.org/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC822	Digital Forensics	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT -1	IAT-2	IAT- 1+IAT -2					
CMC822	Digital Forensics	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To understand the need for digital forensics and the fundamentals of incident response methodology.
2. To study the phases involved in digital forensic investigations.
3. To learn procedures for identification, preservation, and acquisition of digital evidence.
4. To explore forensic tools and techniques used for operating system investigations.
5. To analyze methods and tools used for malware detection and analysis in digital forensics.
6. To understand techniques used in mobile device forensics and browser/email investigation.



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Course Outcomes:

1. Discuss the phases of Digital Forensics and methodology to handle the computer security incident.
2. Describe the process of collection, analysis and recovery of the digital evidence.
3. Explore various tools to analyze malwares and acquired images of RAM/hard drive.
4. Acquire adequate perspectives of digital forensic investigation in mobile devices
5. Analyze the source and content authentication of emails and browsers.
6. Produce unambiguous investigation reports which offer valid conclusions

Prerequisite: Computer Network, Cryptography and System Security

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Digital Forensics	DigitalForensicsDefination, DigitalForensics Goals, Digital Forensics Categories - Computer Forensics, Mobile Forensics, Network Forensics, Database Forensics Introduction to Incident - Computer Security Incident, Goals of Incident Response, CSIRT, Incident Response Methodology, Phase after detection of an incident	6	CO1



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II	Digital Evidence, Forensics Duplication and Digital Evidence Acquisition	Digital evidence, Types of Digital Evidence, Challenges in acquiring Digital evidence, Admissibility of evidence, Challenges in evidence handling, Chain of Custody Digital Forensics Examination Process - Seizure, Acquisition, Analysis, Reporting. Necessity of forensic duplication, Forensic image formats, Forensic duplication techniques,.Acquiring Digital Evidence Forensic Image File Format, Acquiring Volatile Memory (Live Acquisition), Acquiring Nonvolatile Memory (Static Acquisition), Hard Drive Imaging Risks and Challenges, Network Acquisition	9	CO2
III	Forensics Investigation	Analyzing Hard Drive Forensic Images, Analyzing RAM ForensicImage, Investigating Routers Malware Analysis - Malware, Viruses, Worms, Essential skills and tools for Malware Analysis, List of Malware Analysis Tools and Techniques	4	CO3



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IV	Windows and Unix Forensics Investigation	Investigating Windows Systems - File Recovery, Windows Recycle Bin Forensics, Data Carving, Windows Registry Analysis, USB Device Forensics, File Format Identification, Windows Features Forensics Analysis, Windows 10 Forensics, Cortana Forensics Investigating Unix Systems - Reviewing Pertinent Logs, Performing Keyword Searches, Reviewing Relevant Files, Identifying Unauthorized User Accounts or Groups, Identifying Rogue Processes, Checking for Unauthorized Access Points, Analyzing Trust Relationships	8	CO4
V	Mobile Forensics	Android Forensics, Mobile Device Forensic Investigation - Storage location, Acquisition methods, Data Analysis GPS forensics - GPS Evidentiary data, GPS Exchange Format (GPX), GPX Files, Extraction of Waypoints and TrackPoints, Display the Tracks on a Map. SIM Cards Forensics - The Subscriber Identification Module (SIM), SIM Architecture, Security, Evidence Extraction.		



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VI	Browser, Email Forensic & Forensic Investigation Reporting	Web Browser Forensics, Google chrome, Other web browser investigation mail forensics - Sender Policy Framework (SPF), Domain Key Identified Mail (DKIM), Domain based Message Authentication Reporting and Confirmation (DMARC) Investigative Report Template, Layout of an Investigative Report, Guidelines for Writing a Report	4	CO6

Text Books:

1. Kevin Mandia, Chris McGrawHill, 2006
2. Digital Forensics Basics A Practical Guide Using Windows OS — Nihad A. Hassan, APress Publication, 2019
3. Xiaodong HYPERLINK "<https://www.pdfdrive.com/search?q=Xiaodong%2BLin>" HYPERLINK "<https://www.pdfdrive.com/search?q=Xiaodong%2BLin>" Lin, —Introductory Computer Forensics: A Hands-on Practical Approach, Springer Nature, 2018

Online References:

Suggested MOOC Course Links	
1	Course on —Ethical Hacking https://nptel.ac.in/courses/106/105/106105217/
2	Course on —Digital Forensics https://onlinecourses.swayam2.ac.in/cec20_lb06/preview
3	Course on Cyber Incident Response https://www.coursera.org/learn/incident-response



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4	Course on —Penetration Testing, Incident Responses and Forensics https://www.coursera.org/learn/ibm-penetration-testing-incident-response-forensics



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theor y	Pract.	Tut.	Total
CMC823	Applied Data Science	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Tota l
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT- 1	IAT-2	IAT- 1+IA T-2					
CMC823	Applied Data Science	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts and workflow of Data Science.
2. To provide knowledge of data collection, preprocessing, and cleaning techniques.
3. To develop an in-depth understanding of data exploration and visualization methods.
4. To familiarize students with various anomaly detection techniques.
5. To study and apply machine learning techniques used in data science applications.
6. To understand the use of data science techniques across various real-world domains and applications.



Course Outcomes:

1. To gain fundamental knowledge of the data science process.
2. To apply data exploration and visualization techniques.
3. To apply anomaly detection techniques.
4. To gain an in-depth understanding of time-series forecasting.
5. Apply different methodologies and evaluation strategies.
6. To apply data science techniques to real world applications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Data Science	Introduction to Data Science, Data Science Process Motivation to use Data Science Techniques: Volume, Dimensions and Complexity, Data Science Tasks and Examples. Overview of Data Preparation, Modeling, Difference between data science and data analytics	2	CO1
II	Data Exploration	Types of data, Properties of data Descriptive Statistics:	8	CO2



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		Univariate Exploration: Measure of Central Tendency, Measure of Spread, Symmetry, Skewness: Karl Pearson Coefficient of skewness, Bowley's Coefficient, Kurtosis Multivariate Exploration: Central Data Point, Correlation, Different forms of correlation, Karl Pearson Correlation Coefficient for bivariate distribution Inferential Statistics: Overview of Various forms of distributions: Normal, Poisson, Test Hypothesis, Central limit theorem, Confidence Interval, Z-test, t-test, Type-I, Type-II Errors, ANOVA		
III	Methodology and Data Visualization	Methodology: Overview of model building, Cross Validation, K-fold cross validation, leave-1 out, Bootstrapping Data visualization Univariate Visualization: Histogram, Quartile, Distribution Chart Multivariate Visualization:	6	CO3



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		Scatter Plot, Scatter Matrix, Bubble chart, Density Chart Roadmap for Data Exploration Self-Learning Topics: Visualizing high dimensional data: Parallel chart, Deviation chart, Andrews Curves.		
IV	Anomaly Detection	Outliers, Causes of Outliers, Anomaly detection techniques, Outlier Detection using Statistics Outlier Detection using Distance based method, Outlier detection using density-based methods, SMOTE	6	CO4
V	Time Series Forecasting	Taxonomy of Time Series Forecasting methods, Time Series Decomposition Smoothing Methods: Average method, Moving Average smoothing, Time series analysis using linear regression, ARIMA Model, Performance Evaluation: Mean Absolute Error, Root Mean Square Error, Mean Absolute Percentage Error, Mean Absolute Scaled Error	4	CO5



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		Self-Learning Topics: Evaluation parameters for Classification, regression and clustering.		
VI	Applications of Data Science	Predictive Modeling: House price prediction, Fraud Detection Clustering: Customer Segmentation Time series forecasting: Weather Forecasting Recommendation engines: Product recommendation	4	CO6

Textbooks:

1. Vijay Kotu, Bala Deshpande. —Data Science Concepts and Practicell, Elsevier, M.K. Publishers.
2. Steven Skiena, —Data Science Design Manuall, Springer International Publishing AG
3. Samir Madhavan. —Mastering Python for Data Sciencell, PACKT Publishing.
4. Dr. P. N. Arora, Sumeet Arora, S. Arora, Ameet Arora, —Comprehensive Statistical Methods, S.Chand Publications, New Delhi.

References:

1. Jake VanderPlas. —Python Data Science Handbookll, O'reilly Publications.
2. Francesco Ricci, LiorRokach, BrachaShapira, Paul B. Kantor, —Recommender Systems Handbook Springer.
3. S.C. Gupta, V. K. Kapoor —Fundamentals of Mathematical Statisticsll, S. Chand and Sons, New Delhi.
4. B. L. Agrawal. —Basic Statisticsll, New Age Publications, Delhi.



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Online References:

Sr. No.	Website Name
1	https://onlinecourses.nptel.ac.in/noc22_cs32/preview
2	https://onlinecourses.nptel.ac.in/noc21_cs69/preview

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC831	Optimization in Machine Learning	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
CMC831	Optimization in Machine Learning	20	20	40	60	2.5	--	--	100

Course Objectives:

1. Understand the principles of derivative-based optimization algorithms.
2. Analyze the behavior and performance of various optimization techniques.
3. Apply derivative-based optimization algorithms to solve mathematical and engineering problems.
4. Understand and implement stochastic optimization methods.
5. Analyze and apply convex optimization techniques in the context of machine learning problems.
6. Apply evolutionary algorithms to solve real-life optimization problems effectively.



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Course Outcomes:

1. To understand foundational concepts in optimization, including gradient descent and stochastic gradient methods.
2. To study the mathematical formulation and properties of convex optimization problems.
3. To apply convex optimization algorithms to real-world scenarios.
4. To analyze and implement population-based methods in evolutionary computation.
5. To explore and apply advanced evolutionary algorithms such as Particle Swarm Optimization.
6. To understand and apply Ant Colony Optimization techniques for solving complex optimization problems.

Prerequisite: Engineering Mathematics, Algorithms and data structures

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Background to Optimization Theory	Basic Ingredients of Optimization Problems, Optimization Problem Classifications, Optima Types, Optimization Method Classes, Overview of Unconstrained and Constrained Optimization, Basics of convex optimization	4	CO1



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II	Derivative based Optimization	The Basics of Optimization (univariate, bivariate and multivariate optimization), Convex Objective Functions First-Order optimization Methods : Gradient Descent, Conjugate Gradient, Momentum, Nesterov Momentum, Adagrad, RMSProp, learning rate optimization Second order optimization: Newton method	10	CO2
III	Stochastic Methods	Noisy Descent, Mesh Adaptive Direct Search, Cross-Entropy Method, Natural Evolution Strategies, Covariance Matrix Adaptation	6	CO3



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IV	Convex Optimization	Optimization problems, Convex optimization, Linear optimization problems, Quadratic optimization problems, Geometric programming, Overview of Generalized inequality constraints and Vector optimization	6	CO4
V	Evolutionary Methods	Introduction to Evolutionary Computation: Generic Evolutionary Algorithm, Representation: The Chromosome, Initial Population, Fitness Function, Selection: Selective Pressure, Random Selection, Proportional Selection, Tournament Selection, Rank-Based Selection, Elitism and Evolutionary Computation versus Classical Optimization, Stopping conditions Canonical Genetic Algorithm, Binary Representations of Crossover and Mutation: Binary Representations, Control Parameters	8	CO5



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VI	Advance Evolutionary Methods	Basic Particle Swarm Optimization, Global Best PSO, Local Best PSO, g-best versus l-best PSO, Velocity Components, Geometric Illustration, Algorithm Aspects, Social Network Structures Ant Colony Optimization Meta-Heuristic, Foraging Behavior of Ants, Stigmergy and Artificial Pheromone, Simple AntColony Optimization, Ant System, Ant Colony System	5	CO6

Textbooks:

1. Mykel J. Kochenderfer, Tim A.Wheeler, Algorithms for Optimization, MIT Press (2019)
2. Andries P Engelbrecht, Computational Intelligence-An Introduction, Second-Edition, Wiley publication
3. Charu C. Aggarwal, Linear Algebra and Optimization for Machine Learning, , Springer,2020.

References:

1. SuvritSra, Sebastian Nowozin, Stephen J. Wright, Optimization for Machine Learning, The MIT Press
2. Xin-She Yang Middlesex ,Optimization techniques and applications with examples, Wiley
3. A.E. Eiben, J. E. Smith, Introduction to Evolutionary Computing, Springer



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Online References:

Sr. No.	Website Name
1	onvex HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " optimization HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ " HYPERLINK " https://archive.nptel.ac.in/courses/111/104/111104068/ "(NPTEL)
2	Constrained HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "and HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "Unconstrained HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ "optimization HYPERLINK " https://archive.nptel.ac.in/noc/courses/noc21/SEM2/noc21-ma38/ " (NPTEL)



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3	Machine-learning-model-performance (Coursera)
4	Deep-neural-network HYPERLINK "https://www.coursera.org/learn/deep-neural-network" HYPERLINK "https://www.coursera.org/learn/deep-neural-network"optimization HYPERLINK "https://www.coursera.org/learn/deep-neural-network" (Coursera



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC832	High Performance Computing	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT-2	IAT- 1+IA T-2					
CMC832	High Performance Computing	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental concepts of High-Performance Computing (HPC) architecture and parallel computing.
2. To understand the design and analysis of parallel algorithms for computational efficiency.
3. To study various parallel programming models and paradigms.
4. To develop and implement parallel algorithms using MPI (Message Passing Interface).

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5. To explore parallelization using OpenMP, OpenCL, and CUDA frameworks.
6. To introduce the use of High-Performance Computing in cloud environments and related applications.

Course Outcomes:

1. Understand parallel and pipeline processing approaches
2. Design a parallel algorithm to solve computational problems and identify issues in parallel programming.
3. Analyze the performance of parallel computing systems for clusters in terms of execution time, total parallel overhead, speedup.
4. Develop efficient and high-performance parallel algorithms using OpenMP and message passing paradigm
5. Develop high-performance parallel programming using OpenCL and CUDA framework
6. Perform the range of activities associated with High Performance Computing in Cloud Computing

Prerequisite: Computer Architecture, Operating System, Cloud Computing



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Parallel Computing	Classification Models: Architectural Schemes(Flynn's, Shore's, Feng's, Handler's) Memory Access: Distributed Memory, Shared Memory, Hybrid Distributed Shared Memory Parallel Architecture: Pipeline Architecture: Arithmetic pipelines, Floating Point, Array Processorism (What, Why, Applications), Levels of parallelism(instruction, transaction, task, thread, memory, function)	5	CO1
II	Parallel Programming Platform and Algorithm Design	Parallel Programming Platform: Physical Organization of Parallel Platforms Communication Costs in Parallel Machines Algorithm Design: Preliminaries Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models	11	CO2



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III	Performance Measures	Performance Measures: Speedup, execution time, efficiency, cost, scalability, Effect of granularity on performance, Scalability of Parallel Systems, Amdahl's Law, Gustavson's Law, Performance Bottlenecks, The Karp Flatt Metric	3	CO3
IV	HPC Programming: OpenMP and MPI HPC Programming: OpenMP	Introduction: Threads, Share memory Architecture, Multi-core processors and Hyperthreading, Fork and join model. OpenMP directives: #pragma omp parallel, Hello world with openMP, #pragma omp for, #pragma omp for schedule. Serial vs Parallel PI program. Synchronisation: Introduction, Private vs Shared variables. Critical section, #pragma omp critical, #pragma omp atomic, #pragma omp barrier, #pragma omp reduction HPC Programming: MPI Introduction: Processes, Multiprocessor programming model, Distributed system programming model, Inter-process communication using message passing: Asynchronous and Synchronous MPI Programming: Hello world problem, mpi_initMPI_sendMPI_Recv, Synchronisation: MPI_Barrier Hybrid (MPI + OpenMP) programming, Hardware requirement, Threads inside Processes, Hybrid Matrix multiplication	10	CO4



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		Message passing vs Share memory communication: Advantages and disadvantage		
V	Parallel programming using accelerators	An Overview of GPGPUs, Introduction to CUDA, Introduction to Heterogeneous Computing using OpenCL, An Overview of OpenCL API, Heterogeneous Programming in OpenCL.	4	CO5
VI	High Performance Computing in the Cloud	Virtualization and Containerization, Parallel Computing Frameworks, Scaling, HPC in the Cloud Use Cases.	4	CO6

Text Books:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar —Introduction to Parallel Computing, 2nd edition, Addison Wesley, 2003.
2. Shane Cook, Morgan Kaufmann —CUDA Programming: A Developer's Guide to Parallel Computing with GPUs, 2012.
3. M. R. Bhujade —Parallel Computing, 2nd edition, New Age International Publishers, 2009.
4. Kai Hwang, Naresh Jotwani, —Advanced Computer Architecture: Parallelism, Scalability, Programmability McGraw Hill, Second Edition, 2010.
5. Georg Hager, Gerhard Wellein, Chapman —Introduction to High Performance Computing for Scientists and Engineers Hall/CRC Computational Science Series, 2011.



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References:

1. Michael J. Quinn —Parallel Programming in C with MPI and OpenMPI by, McGraw Hill Education, 2008.
2. Kai Hwang ,Zhiwei, —Scalable Parallel Computing: Technology, Architecture, Programming, McGraw-Hill Education, 1998.
3. Laurence T. Yang, Minyi Guo, —High-Performance Computing: Paradigm and Infrastructure, by, Wiley, 2006.

Online References:

Sr. No.	Website Name
1	https://nptel.ac.in/courses/112105293
2	https://archive.nptel.ac.in/courses/128/106/128106014/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
CMC833	Social Media Analytics	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- -1	IAT- 2	IAT- 1+IAT -2					
CMC833	Social Media Analytics	20	20	40	60	2.5	--	--	100

Course Objectives:

1. Familiarize the learners with the concept of social media.
2. Familiarize the learners with the concept of social media analytics and understand its significance.
3. Enable the learners to develop skills required for analyzing the effectiveness of social media.
4. Familiarize the learners with different tools of social media analytics.
5. Familiarize the learner with different visualization techniques for Social media analytics.
6. Examine the ethical and legal implications of leveraging social media data.



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Course Outcomes:

1. Understand the concept of Social media
2. Understand the concept of social media Analytics and its significance.
3. Learners will be able to analyze the effectiveness of social media
4. Learners will be able to use different Social media analytics tools effectively and efficiently.
5. Learners will be able to use different effective Visualization techniques to represent social media analytics.
6. Acquire the fundamental perspectives and hands-on skills needed to work with social media data.

Prerequisite: Graph Theory, Data Mining, Python/R programming



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Social Media Analytics: An Overview	Core Characteristics of Social Media, Types of Social Media, Social media landscape, Need for Social Media Analytics (SMA), SMA in small & large organizations. purpose of Social Media Analytics, Social Media vs. Traditional Business Analytics, Seven Layers of Social Media Analytics, Types of Social Media Analytics, Social Media Analytics Cycle, Challenges to Social Media Analytics, Social Media Analytics Tools	6	CO1
II	Social Network Structure, Measures & Visualization	Basics of Social Network Structure - Nodes, Edges & Tie Describing the Networks Measures - Degree Distribution, Density, Connectivity, Centralization, Tie Strength & Trust Network Visualization - Graph Layout, Visualizing Network features, Scale Issues. Social Media Network Analytics - Common Network Terms, Common Social Media Network Types, Types of Networks,	6	CO2



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		Common Network Terminologies, Network Analytics Tools.		
III	Social Media Text, Action & Hyperlink Analytics	Social Media Text Analytics - Types of Social Media Text, Purpose of Text Analytics, Steps in Text Analytics, Social Media Text Analysis Tools Social Media Action Analytics - What Is Actions Analytics? Common Social Media Actions, Actions Analytics Tools Social Media Hyperlink Analytics - Types of Hyperlinks, Types of Hyperlink Analytics, Hyperlink Analytics Tools	8	CO3
IV	Social Media Location & Search Engine Analytics	Location Analytics - Sources of Location Data, Categories of Location Analytics, Location Analytics and Privacy Concerns, Location Analytics Tools Search Engine Analytics - Types of Search Engines, Search Engine Analytics, Search Engine Analytics Tools	6	CO4
V	Social Information Filtering	Social Information Filtering - Social Sharing an filtering , Automated Recommendation systems, Traditional Vs social Recommendation Systems Understanding Social Media and Business Alignment, Social Media KPI, Formulating a	6	CO5



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		Social Media Strategy, Managing Social Media Risks		
VI	Social Media Analytic Applications and Privacy	Social media in public sector - Analyzing public sector social media, analyzing individual users, case study. Business use of Social Media - Measuring success, Interaction and monitoring, case study. Privacy - Privacy policies, data ownership and maintaining privacy online.	7	CO6

Textbooks:

1. Seven Layers of Social Media Analytics_ Mining Business Insights from Social Media Text, Actions, Networks, Hyperlinks, Apps, Search Engine, and Location Data, Gohar F. Khan,(ISBN-10: 1507823207).
2. Analyzing the Social Web 1st Edition by Jennifer Golbeck
3. Mining the Social Web_ Analyzing Data from Facebook, Twitter, LinkedIn, and Other Social Media Sites, Matthew A Russell, O'Reilly
4. Charu Aggarwal (ed.), Social Network Data Analytics, Springer, 2011

References:

1. Social Media Analytics [2015], Techniques and Insights for Extracting Business Value Out of Social Media, Matthew Ganis, AvinashKohirkar, IBM Press
2. Social Media Analytics Strategy_ Using Data to Optimize Business Performance, Alex Gonçalves, APress Business Team -
3. Social Media Data Mining and Analytics, Szabo, G., G. Polatkan, O. Boykin & A. Chalkiopoulos (2019), Wiley, ISBN 978-1-118-82485-6



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Online References:

Useful Links	
1	https://cse.iitkgp.ac.in/~pawang/courses/SC16.html
2	https://onlinecourses.nptel.ac.in/noc20_cs78/preview
3	https://nptel.ac.in/courses/106106146
4	https://7layersanalytics.com/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8401	Project Management	3	-	-	3	-	-	3

		Theory					Term wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT- 2	IAT- 1+IAT -2					
OEC8401	Project Management	20	20	40	60	2.5	--	--	100

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Course Objectives:

1. To introduce students to the fundamentals of project management and the importance of a structure approach in handling unique projects.
2. To develop an understanding of project management concepts, frameworks, and industry best practices.
3. To provide hands-on exposure to various tools and techniques used in planning, executing, and monitoring projects.
4. To explain the complete Project Management Life Cycle, including initiation, planning, execution, monitoring, and closure.
5. To enable students to identify and address project risks, scope, cost, time, and quality constraints.
6. To prepare students for real-world project environments by enhancing their decision-making, leadership, and team collaboration skills.

Course Outcomes:

1. Apply appropriate selection criteria to evaluate and choose the most suitable project from multiple alternatives.
2. Develop a Work Breakdown Structure (WBS) and construct a project schedule based on it.
3. Analyze project risks by identifying potential opportunities and threats, and formulate strategic responses.
4. Apply project monitoring and control techniques, including Earned Value Management (EVM), to assess and forecast project performance.
5. Document and communicate key findings and experiences from various project phases for continuous improvement.
6. Demonstrate the ability to integrate planning, execution, and evaluation skills for successful project completion.

Prerequisite: Basic knowledge of software engineering, management principles, and analytical skills.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	CO1
II	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	CO2



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III	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	CO3
IV	Planning Projects	Crashing project time, Resource loading and levelling, 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	CO4



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V	Executing Projects	Planning monitoring and controlling cycle, Information needs and reporting, engaging with all stakeholders of the projects, Team management, communication and project meetings 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	CO5
VI	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	CO6

Text Books:

1. Project Management: A managerial approach, Jack Meredith & Samuel Mante^{7th} Edition, Wiley India
2. Project Management, Gido Clements, Cengage Learning



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3. Project Management, Gopalan, Wiley India

References:

1. A Guide to the Project Management Body of Knowledge (PMBOK® Guide),

Online Reference :

1. Project Management Institute (PMI) – <https://www.pmi.org>



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8402	Finance Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
OEC8402	Finance Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To provide an overview of the Indian financial system, including its structure, instruments and markets.
2. To introduce fundamental concepts such as the time value of money, risk, and return.
3. To explain the principles and practices of corporate finance.
4. To understand the components and management of working capital.
5. To explore various sources of finance available to businesses.
6. To study financial decision-making areas such as capital structure and dividend policy.



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Course Outcomes :

1. Understand the structure and functioning of the Indian financial system and its key components.
2. Apply the concept of the time value of money in evaluating financial decisions.
3. Analyze risk and return to support sound investment decisions.
4. Demonstrate knowledge of corporate finance principles in business contexts.
5. Effectively manage working capital to maintain business liquidity and operations.
6. Make informed decisions related to capital structure and dividend distribution.

Prerequisite: Basic knowledge of accounting, economics, and business mathematics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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:	6	CO1



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		Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges		
II	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.	6	CO2
III	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.	9	CO3



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IV	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	10	CO4
		Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities.		
V	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	5	CO5



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		Optimal Capital Structure		
VI	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	3	CO6

Text Books:

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.
4. Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8403	Entrepreneurship Development and Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT-1	IAT-2	IAT-1+IA T-2					
OEC8403	Entrepreneurship Development and Management	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamentals of entrepreneurship and its role in business development.
2. To develop understanding of various forms of business ownership and entrepreneurial functions.
3. To provide insights into the Indian entrepreneurial ecosystem and its regulatory environment.
4. To explain the concept and structure of Entrepreneurship Development Programs (EDP).
5. To familiarize students with the significance and functioning of Micro, Small, and Medium Enterprises (MSMEs).



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6. To enable students to analyze the contribution of government and financial institutions in promoting entrepreneurship.

Course Outcomes (Learner will be able to):

1. Understand the core concepts of entrepreneurship and various business ownership models.
2. Prepare and evaluate business plans covering key managerial and financial aspects.
3. Interpret relevant laws and legal procedures applicable to Indian entrepreneurs.
4. Analyze government policies and institutional support systems for entrepreneurs and MSMEs.
5. Apply knowledge of EDPs and their role in skill development and business support.
6. Recognize challenges in entrepreneurship and propose suitable strategies for business growth and sustainable.

Prerequisite: Basic knowledge of business studies and economics.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping



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I	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	4	CO1
II	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,	9	CO2



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		Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance Business Operations		
III	Women's Entrepreneurship Development	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	5	CO3
IV	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	8	CO4
V	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	8	CO5



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VI	Achieving Success In The Small Business	stages of the small business life cycle, four type of firm-level growth strategies, Options harvesting or closing small business Critical Success factors of small business	5	CO6

Text Books:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shepherd, Entrepreneurship, latest edition, The McGrawHill Company
3. Dr TN Chhabra, Entrepreneurship Development, Sun India Publications, New Delhi
4. Dr CN Prasad, Small and Medium Enterprises in Global Perspective, New century Publications, New Delhi
5. Vasant Desai, Entrepreneurial development and management, Himalaya Publishing House

References:

1. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
2. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
3. Law and Practice relating to Micro, Small and Medium enterprises, Taxmann Publication Ltd.
4. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication

Online References:

1. Laghu Udyog Samachar
2. www.msme.gov.in
3. www.dcmesme.gov.in
4. www.msmetraining.gov.in



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8404	Human Resource Management	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IA T-2					
OEC8404	Human Resource Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamental concepts and principles of Human Resource Management (HRM).
2. To explain key HRM techniques and practices used in modern organizational settings.
3. To provide a comprehensive understanding of HRM functions such as recruitment, selection, training, and performance management.
4. To explore the challenges and changes in HRM in the context of evolving organizational dynamics.
5. To familiarize students with the latest trends and technological advancements in HRM.
6. To develop awareness of interpersonal and intergroup behavioral skills essential for

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future engineers, managers, and leaders.

Course Outcomes :

1. Understand the core concepts and techniques of Human Resource Management.
2. Analyze various HRM functions and apply them in the context of organizational processes.
3. Evaluate the challenges and opportunities in HRM in today's rapidly changing business environment.
4. Identify and interpret current developments and trends in HRM practices.
5. Demonstrate effective interpersonal and team-building skills within professional settings.
6. Integrate behavioral understanding with HRM concepts to contribute effectively as future professionals.

Prerequisite: Basic understanding of management principles, organizational behavior, and communication skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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,	5	CO1



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		Empowerment, TQM, Managing ethical issues		
II	Organizational Behaviour (OB)	Introduction to OB Origin, Nature and Scope of Organizational Behaviour, 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 Behaviour • Motivation: Theories of Motivation and their Applications for Behavioural Change (Maslow, Herzberg, McGregor); • Group Behaviour 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		



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III	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.		
IV		Power and Politics: Sources and uses of power; Politics at workplace, Tactics and strategies.		
V	Human resource Planning	- Recruitment and Selection process, Job-enrichment, Empowerment - Job-Satisfaction, employee morale - Performance Appraisal Systems: Traditional & modern methods, Performance Counselling, Career Planning - Training & Development: Identification of Training Needs, Training Methods		
VI	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,		



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		managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation		
		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		

Text Books:

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

References:

1. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 5th Ed, 2015, Himalaya Publishing, 15th edition, 2015
2. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013,



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Himalaya Publishing

3. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
OEC8405	Professional Ethics and Corporate Social Responsibility (CSR)	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the fundamental principles of professional ethics in business.
2. To develop an understanding of ethical decision-making and moral responsibility in organizational settings.

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3. To recognize the scope and significance of Corporate Social Responsibility (CSR) in modern business.
4. To understand the rights and duties of businesses toward various stakeholders.
5. To explore the role of law in shaping and enforcing CSR practices.
6. To promote ethical leadership and responsible corporate behavior.

Course Outcomes :

1. Understand and apply the principles of professional ethics in business contexts.
2. Identify and evaluate the rights and responsibilities of businesses in a societal framework.
3. Analyze various aspects and dimensions of corporate social responsibility.
4. Demonstrate awareness of legal and regulatory aspects related to CSR.
5. Make ethically sound decisions in professional and organizational settings.
6. Promote socially and environmentally responsible behavior as future professionals and leaders.

Prerequisite: Basic knowledge of business management, ethics, and legal framework



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	4	CO1
II	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	8	CO2



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III	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.	6	CO3
IV	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	5	CO4
V	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	8	CO5



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VI	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.	8	C06

Text Books:

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.

References:

1. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
2. Corporate Social Responsibility in India (2015) by Bidyut Chakrabarty, Routledge, New Delhi.

Online References:

1. <https://www.ethics.org> – The Ethics & Compliance Initiative (ECI)
2. <https://www.csrwire.com> – News and reports on Corporate Social Responsibility.
3. <https://www.globalreporting.org> – Global Reporting Initiative (GRI) for CSR frameworks



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8406	Research Methodology	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n(in Hrs)			
		IAT- 1	IAT- 2	IAT- 1+IAT -2					
OEC8406	Research Methodology	20	20	40	60	2.5	--	--	100

Course Objectives:

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1. To introduce the basic concepts and significance of research in academic and professional contexts.
2. To explain the research process, including various types and approaches to research.
3. To guide students in identifying suitable research problems and formulating research questions.
4. To develop skills in designing effective research strategies and methodologies.
5. To familiarize students with data collection methods and tools.
6. To provide an understanding of data analysis, interpretation, and reporting of research findings.



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Course Outcomes :

1. Understand and apply the fundamental principles of research and the research process.
2. Identify and define research problems relevant to their domain.
3. Design a structured research plan with appropriate methodologies.
4. Collect, organize, and analyze data accurately using suitable tools.
5. Interpret and evaluate research data to derive meaningful conclusions.
6. Effectively present and communicate research findings in a clear and logical manner.

Prerequisite: Basic understanding of research methodology, including types of research, hypothesis formulation, and data collection techniques.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	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	4	CO1
II	Types of Research	Types of Research • Basic Research • Applied Research • Descriptive Research • Analytical Research • Empirical Research Qualitative and Quantitative Approache	4	CO2



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III	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	10	CO3
IV	Research Methodology	Meaning of Research Methodology 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	10	CO4
V	Formulating Research Problem	.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of	8	CO5



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		data, Generalization and Interpretation of analysis		
VI	Outcome of Research	Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	6	CO6

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



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8407	IPR and Patenting	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duratio n (in Hrs)			
		IAT-1	IAT- 2	IAT- 1+IA T-2					
OEC8407	IPR and Patenting	20	20	40	60	2	--	--	100

Course Objectives:

1. To provide a fundamental understanding of the intellectual property rights (IPR) protection system.
2. To explain various types of intellectual property such as patents, copyrights, trademarks, and designs.
3. To promote awareness of Indian IPR laws and their relevance in business and innovation.
4. To familiarize students with international IPR treaties and procedures (e.g., WIPO, TRIPS).
5. To acquaint students with patent search tools, databases, and techniques.
6. To explain the procedures for filing patent applications and other IPR registrations.



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Course Outcomes:

1. Understand and identify various forms of intellectual property assets.
2. Explain the legal framework of IPR in India and globally.
3. Conduct basic patent and IPR-related searches using appropriate tools.
4. Describe the procedures involved in patent filing and other IPR applications.
5. Evaluate the role of IPR in fostering innovation and protecting inventions.
6. Assist individuals and organizations in building IPR awareness and compliance capabilities.

Prerequisite: Basic understanding of legal concepts and fundamentals of innovation or product Development.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Intellectual Property Rights (IPR)	Meaning of IPR, Different category of IP 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	5	CO1



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II	Enforcement of Intellectual Property Rights	Introduction, Magnitude of problem, Factor that create and sustain counterfeiting/piracy International agreements, International organizations (e.g. WIPO, WTO) active in IP 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.	7	CO2



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III	Emerging Issues in IPR	Challenges for IP in digital economy, e-commerce, human genome, biodiversity and traditional knowledge etc.	5	CO3
IV	Basics of Patents	Definition of Patents, Conditions of patentability Patentable and non-patentable inventions, Type of patent applications (e.g Patent of addition etc) Process Patent and Product Patent, Precaution while patenting Patent specification Patent claims Disclosure and non-disclosures, Patent rights and infringement, Method of getting a patent	7	CO4
V	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.)	8	CO5
VI	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, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	7	CO6



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REFERENCES:

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
7. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
8. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
9. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
10. Entrepreneurship Development and IPR Unit, BITS Pilani, 2007, A Manual on Intellectual Property Rights,
11. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company



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12. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting
, Interpretation of Patent Specifications and Claims, New India Publishing Agency.
13. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
14. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8408	Digital Business Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IAT-1	IAT-2	IAT-1+IA T-2					
OEC8408	Digital Business Management	20	20	40	60	2	--	--	100

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Course Objectives:

1. To introduce students to the fundamental concepts of digital business.
2. To provide an understanding of the evolution and scope of e-commerce in the digital age.
3. To explore various models, tools, and platforms used in digital business environments.
4. To explain the components, infrastructure, and technologies that support e-business.
5. To analyze strategies for developing and managing successful e-business initiatives.
6. To encourage entrepreneurial thinking through the creation of digital business plans.

Course Outcomes :

1. Understand and define key concepts and drivers of digital business.
2. Distinguish between different types of e-commerce and their business models.
3. Apply digital tools and technologies for managing online business operations.
4. Analyze and evaluate e-business strategies and their implementation.
5. Demonstrate familiarity with legal, ethical, and security issues in digital business.
6. Design and present a comprehensive e-business plan.

Prerequisite: Basic knowledge of internet technologies, business processes, and information systems.



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Digital Business-	Introduction, Background and current status of E-market places, structures, mechanism economics and impacts difference between physical economy and digital economy,	9	CO1
		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,		



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II	Overview of E-Commerce	-Commerce- Meaning, Retailing i e commerce-products and services consumer behavior, market research an advertisement 2B-E-commerce-selling and buying i private e-markets, public B2B exchange and support services, e-supply chains Collaborative Commerce, Intra business E and Corporate portals ther E-C models and application innovative EC System-From E- government and learning to C2C, mobile commerce an pervasive computing C Strategy and Implementation-EC strateg and global EC, Economics and Justificatio of EC, Using Affiliate marketing to promot your e-commerce business, Launching successful online business and EC project Legal, Ethics and Societal impacts of EC	6	CO2
III	Digital Business Support services	ERP as e –business backbone, knowledge Tope Apps, Information and referral system	6	CO3



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		Application Development: Building Digital business Applications and Infrastructure		
IV	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	6	CO4
V	E-Business Strategy-	E-Business Strategy-E-business Strategy formulation- Analysis of Company Internal and external environment Selection of strategy, E-business strategy into Action challenges and E-Transition Process of Digital Transformation)	4	CO5
VI	Materializing e-business:	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	8	CO6



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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 OECD Publishing



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R-2025- BE Computer Engineering

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
OEC8409	Environmental Management	3	-	-	3	-	-	3

		Theory					Ter m wor k	Pract / Oral	Total
		Internal Assessment			End Sem Exa m	Exam Duratio n (in Hrs)			
		IAT-1	IAT-2	IAT-1+IA T-2					
OEC8409	Environmental Management	20	20	40	60	2	--	--	100

Course Objectives:

1. To introduce students to the fundamentals of environmental science and the significance of environmental management in current industrial and social contexts.
2. To create awareness of global environmental challenges and the role of human activities in causing environmental degradation.
3. To develop a scientific understanding of ecological principles and ecosystem dynamics, including interdependencies among living organisms.
4. To familiarize students with the role of government and industries in environmental management and regulation.
5. To provide knowledge of environmental quality management systems, including ISO standards and Environmental Management Systems (EMS).



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6. To acquaint students with major environmental legislations and legal frameworks for sustainable and responsible development.

Course Outcomes:

1. Understand the importance of environmental management and sustainable development in addressing contemporary environmental challenges.
2. Analyze major global environmental issues such as global warming, acid rain, and biodiversity loss and their impact on ecosystems.
3. Explain key ecological concepts including ecosystems, limiting factors, food chains, and interdependencies in nature.
4. Evaluate the role of government and industries in implementing environmental management strategies and regulatory policies.
5. Demonstrate knowledge of environmental quality standards such as Total Quality Environmental Management, ISO 14000, and EMS certification.
6. Interpret the provisions and implications of major environmental legislations like the EPA, Water and Air Acts, and Wildlife Protection Act.



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Prerequisite: Basic understanding of science and awareness of current environmental issues.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction and Definition of Environment:	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	CO1



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II	Global Environmental concerns	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.	6	CO2
III	Concepts of Ecology	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	5	CO3
		Scope of Environment Management, Role and functions of Government as a planning and regulating agency Environment Quality Management and Corporate Environmental Responsibility		
		Total Quality Environmental Management, ISO-14000, EMS certification.		
		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.		



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IV	Scope of Environment Management	Role and functions of Government as a planning and regulating agency environment Quality Management and Corporate Environmental Responsibility	10	CO4
V	Quality Environmental Management,	Total Quality Environmental Management, ISO-14000, EMS certification.	5	CO5
VI		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.	3	CO6



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