

Department of Electronics and Computer Science

Curriculum FE to BE for A.Y 2025-26

First Year to Final Year Syllabus

Prepared by: Board of Studies for Electronics and Computer Science

**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

Preface

Dear Colleagues and Esteemed Members of the Board,

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

The Electronics and Computer Science (ECS) program at our autonomous institute under Mumbai University is a forward-looking, interdisciplinary course that combines the robust foundations of electronics with the transformative capabilities of computer science. The program equips students with the knowledge and skills needed to design, develop, and optimize intelligent systems, enabling innovation at the intersection of hardware and software.

As an autonomous institution, we utilize academic independence to continuously update and enrich the curriculum to reflect emerging technologies and industry demands, including areas such as Internet of Things (IoT), artificial intelligence, embedded systems, robotics, and cyber-physical systems.

A key feature of the program is the integration of the Idea Lab, a dynamic innovation ecosystem where students engage in hands-on, project-based learning. This lab nurtures creativity, design thinking, and entrepreneurial mindsets, enabling students to take ideas from concept to prototype, often in collaboration with industry, faculty, and the community.

The ECSE program strongly emphasizes societal impact. Students are encouraged to develop technology-driven solutions to address real-world challenges, particularly in alignment with the United Nations Sustainable Development Goals (UN SDGs). Whether it is promoting quality education (SDG 4) through ed-tech innovations, enhancing good health and well-being (SDG 3) with biomedical devices, contributing to sustainable cities and communities (SDG 11) through smart systems, or driving climate action (SDG 13) using intelligent environmental monitoring, the curriculum instills a deep sense of purpose and responsibility.

Through a balance of theoretical grounding, practical application, ethical awareness, and social commitment, the ECSE program prepares graduates to become technological leaders, responsible citizens, and agents of sustainable development in a rapidly evolving global landscape.

Mrs. Samita Bhandari
Chairperson, Board of Studies (ECS), SLRTCE

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1. Abbreviations

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

2. Curriculum Structure and Examination Scheme for B.E. in Electronics and Computer Science

(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	
13111101	BSC	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3
13111102	BSC	Basics of Semiconductor Physics	2	--	--	30	--	--	30	60	2
13121103	ESC	Basic Electrical and Electronics Engineering	3	--	--	45	--	--	45	90	3
13121104	ESC	Engineering Graphics & Design	2	--	--	30	--	--	30	60	2
13121105	ESC	C and C++ Programming	3	--	--	45	--	--	45	90	3
13112106	BSCL	Basics of Semiconductor Physics Lab	--	--	1	--	--	15	--	15	0.5
13122107	ESCL	Basic Electrical and Electronics Engineering Lab	--	--	2	--	--	30	--	30	1
	ESCL	Engineering Graphics &	--	--	2	--	--	30	--	30	1

13122108		Design Lab									
13122109	ESCL	C and C++ - Programming Lab	--	--	2	--	--	30	--	30	1
13122110	ESCL	IDEA LAB-I (Innovation Design Engineering and Apply)	1	--	2*	15	-	30	15	60	2
13412111	VSEC	Workshop -1	--	--	2	--	--	30	15	45	1.5
98462112	CC	NSS & Civil Defense	-	--	4#	--	--	60	-	60	2
98441113	IKS	Indian Knowledge System	2	--	--	30	--	--	30	60	2
Total			15	1	15	225	15	225	255	720	24

Note:

- 1) CC and IKS will be common to all Branch
- 2) BSC, ESC and corresponding lab is Department Specific
- 3) Questions based on self-learning must not be asked in internal assessment and End Semester Exam
- 4) ***IDEA Lab** :The IDEA Lab fosters individual interdisciplinary projects through theme-based, subject-integrated, experiential learning, assessed via standardized rubrics for innovation, application, and documentation."
- 5) # Students need to complete 60 hours throughout the semester as it is not possible to get 4 hours per week due to the dynamic schedule of Govt. agencies.
Notional Learning Hours: In higher education, Notional Learning Hours (NLH) indicates the estimated time that a typical learner, at a specific academic level, is expected to invest in order to achieve the set learning outcomes of a course or module. This time includes a range of structured and independent learning activities, each contributing to the development of knowledge and competencies within a module

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practicals, and examinations. Additionally, self-learning includes topics that go beyond the prescribed syllabus to align with current industry trends and requirements. Assessment of self-learning will follow a formative approach. For theory subjects that include term work, 30% of the assignment questions and student presentations/discussions should be based on self-learning topics. In subjects without term work, the corresponding laboratory sessions will incorporate self-learning, carrying a weightage of 30%. The subject with no term work and practical will have no assessment on self-learning topics. This may involve lab work using the latest tools or preparing technical write-ups/research papers on

advanced topics.

Examination Scheme – FE Semester-I

Course Code	Course Type	Course Name	Examination Scheme							
			IAT-1	IAT-2	Total	End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Practical & Oral	Total
13111101	BSC	Linear Algebra and Calculus	20	20	40	60	2.5	25	–	125
13111102	BSC	Basics of Semiconductor Physics	20	20	40	60	2.5	–	–	100
13121103	ESC	Basic Electrical and Electronics Engineering	20	20	40	60	2.5	–	–	100
13121104	ESC	Engineering Graphics & Design	20	20	40	60	2.5	–	–	100
13121105	ESC	C - Programming	20	20	40	60	2.5	–	–	100
13112106	BSCL	Basics of Semiconductor Physics Lab	–	–	–	–	–	25	–	25
13122107	ESCL	Basic Electrical and Electronics Engineering Lab	–	–	–	–	–	25	25	50
13122108	ESCL	Engineering Graphics & Design Lab	–	–	–	–	–	25	25	50
13122109	ESCL	C and C++ Programming Lab	–	–	--	–	--	25	25	50
13122110	ESCL	IDEA LAB -I- (Innovation Design Engineering and Apply)	–	–	--	–	--	50	50	100
13412111	VSEC	Workshop -1	-	-	-	-	-	25	-	25
98462112	CC	NSS & Civil Defense	-	-	-	---	--	25	--	25
98441113	IKS	Indian Knowledge System	20	20	40	60	2.5	--	--	100
Total			120	120	240	360	15	225	125	950

Curriculum Structure – FE Semester-II

Course Code	Course Type	Course Name	Teaching Scheme (Contact Hours Per Week)			Teaching Scheme (Contact Hours Per Semester)					Total Credits (C) (Notional Learning Hour/30)
			L	T	P	L	T	P	SL	Notional Learning Hour	
13111201	BSC	Probability, Statistics, and Differential Equations	2	1	--	30	15	--	45	90	3
13111202	BSC	Engineering chemistry for Electronics	2	--	--	30	--	--	30	60	2
13121203	ESC	Engineering Mechanics	2	--	--	30	--	--	30	60	2
13211204	PCC	Digital Electronics	3	--	--	45	--	--	45	90	3
13112205	BSCL	Engineering chemistry for Electronics Lab	--	--	1	--	--	15	-	15	0.5
13122206	ESCL	Engineering Mechanics Lab	--	--	2	--	--	30	-	30	1
13122207		Programming Lab (Python)	2	--	2	30	--	30	-	60	2
13122208	ESCL	IDEA LAB - II(Innovation Design Engineering and Apply	1	-	2*	15	-	30	15	60	2
13212209	PCCL	Digital Electronics Lab	--	-	2	--	--	30	-	30	1
13412210	VSEC	Workshop 2	-	-	2	--	--	30	15	45	1.5
98461211	CC	Universal Human Values	2	-	--	30	--	-	30	60	2
98421212	AEC	Enterprise Communication and corporate culture	1	--	-	15	--	-	15	30	1
98422213	AECL	Enterprise Communication And Corporate Culture Lab	-	-	2	--		30	-	30	1
		Audit Course	3	--	--	45	--	--	--	--	--
Total			18	1	13	270	15	195	225	660	22

Note:

- 1) AEC 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							
			IAT-1	IAT-2	Total	End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)	Term Work	Pract & Oral	Total
13111201	BSC	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	–	125
13111202	BSC	Engineering Chemistry for Electronics	20	20	40	60	2.5	-	-	100
13121203	ESC	Engineering Mechanics	20	20	40	60	2.5	-	-	100
13211204	PCC	Digital Electronics	20	20	40	60	2.5	-	-	100
13112205	BSCL	Engineering Chemistry for Electronics Lab	-	-	-	-	-	25	–	25
13122206	ESCL	Engineering Mechanics Lab	-	-	-	-	-	25	25	50
13122207	ESCL	Programming Lab (Python)	-	-	-	-	-	25	25	50
13122208	ESCL	IDEA LAB -II (Innovation Design Engineering and Apply	-	-	-	-	-	50	50	100
13212209	PCCL	Digital Electronics Lab	-	-	-	-	-	25	25	50
13412210	VSEC	Workshop-II	-	-	-	-	-	25	-	25
98461211	CC	Universal Human Values	-	-	-	-	-	25	–	25
98421212	AEC	Enterprise Communication and corporate culture	20	20	40	40	1.5	-	--	80
98422213	AECL	Enterprise Communication and Corporate Culture Lab	-	-	-	-	-	25	-	25
Total			100	100	200	280	11.5	250	125	855

Note:

- 1) AEC 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."

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.

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	
13211301	PCC	Mathematical Foundations for Electronics and Computer Science	2	1	–	30	15	–	45	90	3
13211302	PCC	Electronic Devices and Circuits	3	--	--	45	--	--	45	90	3
13211303	PCC	Computer Organization and Architecture	3	--	–	45	--	--	45	90	3
13211304	PCC	Data Structures and Algorithms	3	–	–	45	--	--	45	90	3
13212305	PCCL	Electronic Devices and Circuit Lab	–	-	2	--	--	30	--	30	1
13212306	PCCL	Data Structures and Algorithms Lab.	–	--	2	--	--	30	--	30	1
9951137XX	OE	To be selected from the bucket proposed by other institute of Rahul Education	2	-	–	30	--	--	30	60	2
98431308	Entrepreneurship	Entrepreneurship Development	2	-	–	30	--	--	30	60	2
98451309	Value Education	Environmental Science	2	-	–	30	--	--	30	60	2

	Course										
13612310	Community Engagement Project	IDEA LAB-III (Innovation Design Engineering and Apply	1	--	2*	15	--	30	15	60	2
Total			18	1	6	270	15	90	285	660	22

Note:

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

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

Self-Learning (SL): Self-learning is integrated into both theory and practical subjects, particularly where practical sessions have only one contact hour per week. It emphasizes student-driven efforts in preparing for assignments, practical, 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	Pract & Oral	Total
			In-Semester Assessment\$			End Sem. Exam (ESE)	Exam Duration for Theory (in Hrs)			
			IAT-1	IAT-2	Total					
13211301	PCC	Mathematical Foundations for Electronics and Computer Science	20	20	40	60	2.5	25	—	125
13211302	PCC	Electronic Devices and Circuits	20	20	40	60	2.5	—	—	100
13211303	PCC	Computer Organization and Architecture	20	20	40	60	2.5	—	—	100
13211304	PCC	Data structures and Algorithms	20	20	40	60	2.5	—	—	100
13212305	PCCL	Electronic Devices and circuits Lab	—	—	—	—	—	25	25	50
13212306	PCCL	Data Structures and Algorithms Lab.	—	—	—	—	—	25	25	50
9951137XX	OE	To be selected from the bucket Rahul Education	—	—	—	—	—	25	—	25
98431308	Entrepreneurship	Entrepreneurship Development	—	—	—	—	—	25	—	25
98451309	Value Education Course	Environmental Science	20	20	40	60	2.5	—	—	100

13612310	Community Engagement Project	IDEA LAB - III(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	
13211401	PCC	Sampling Theory and Optimization	2	1	-	30	15	-	45	90	3
13211402	PCC	Analog Electronics	3	-	-	45	-	-	45	90	3
13211403	PCC	Discrete Structure and Automata Theory	3	-	-	45	-	-	45	90	3
13212404	PCCL	Analog Electronics lab	-	-	2	-	-	30	-	30	1
13212405	PCCL	IDEA LAB - IV(Innovation Design Engineering and Apply	1	-	2*	15	-	30	15	60	2
13412406	VSEC	Skill lab	-	-	2	-	-	30	-	30	1

		Java									
993114701WW	MDM	To be selected from MDM bucket	3	-	-	45		-	45	90	3
9931248WW	MDML	To be selected from MDM bucket	-	-	2	-	-	30	-	30	1
9951149WW	OE	To be selected from the bucket Rahul Education	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	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."

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Examination Scheme – SE Semester-IV

Course code	Course Type	Course Name	Examination Scheme							Total
			In-Semester Assessment			End Sem Exam	Exam Duration for Theory (in Hrs)	Term Work	Pract. & Oral	
			IAT-1	IAT-2	Total					
13211401	PCC	Sampling Theory and Optimization	20	20	40	60	2.5	25	–	125
13211402	PCC	Analog Electronics	20	20	40	60	2.5	–	–	100
13211403	PCC	Discrete Structure and Automata Theory	20	20	40	60	2.5	–	–	100
13212404	PCCL	Analog Electronics lab	–	–	–	–	–	25	25	50
13212405	PCCL	IDEA LAB - IV(Innovation Design Engineering and Apply	–	–	–	–	–	50	50	100
13412406	VSEC	Skill lab Java	–	–	–	–	–	25	25	50
9931147WW	MDM	To be selected from MDM bucket	20	20	40	60	2.5	–	–	100
9931248WW	MDML	To be selected	–	–	–	–	–	25	25	50

		from MDM bucket								
9951149WW	OE	OE	–	--	–	–	--	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	ECC501	Communication Engineering	3	-	-	3	-	-	3
PCC	ECC502	Computer Organization and Architecture	3	-	-	3	-	-	3
PCC	ECC503	Software Engineering	3	-	-	3	-	-	3
PCC	ECC504	Web Technologies	3	-	-	3	-	-	3
PCC	ECC55X	Professional Elective Course – 1	3	-	-	3	-	-	3
PCCL	ECL506	Communication Engineering Lab	-	2			1		1
PCCL	ECL507	Software Engineering Lab	-	2	-	-	1	-	1
PCCL	ECL508	Web Technologies Lab	-	2	-	-	1	-	1
PCCL	ECL509	Professional Communication and Ethics-II	-	2* +2	-	-	2	-	2
PCCL	ECL510	Mini project - 2A	-	4\$	-	-	2	-	2
Total			15	14	-	15	7	7	22

**Theory class; \$ indicates workload of learner (Not faculty), for mini-project*

Examination Scheme – TE Semester-V

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract. / Oral	Total
		IAT 1	IAT 2	Total					
ECC501	Communication Engineering	20	20	40	60	2.5	-	-	100
ECC502	Computer Organization and Architecture	20	20	40	60	2.5	-	-	100
ECC503	Software Engineering	20	20	40	60	2.5	-	-	100
ECC504	Web Technologies	20	20	40	60	2.5	-	-	100
ECC55X	Professional Elective Course – 1	20	20	40	60	2.5	-	-	100
ECL506	Communication Engineering Lab	-	-	-	-	-	25	25	50
ECL507	Software Engineering Lab	-	-	-	-	-	25	25	50
ECL508	Web Technologies Lab	-	-	-	-	-	25	25	50
ECL509	Professional Communication and Ethics-II	-	-	-	-	-	25	25	50
ECL510	Mini project - 2A						25	25	50
						-			

Total			200	300		150	100	750

	Professional Elective Course – 1
ECC551	Software Testing and Quality Assurance
ECC552	ASIC Verification
ECC553	Information Theory and Coding
ECC554	Sensors and Applications

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	ECC601	Embedded Systems and RTOS	3	-	-	3	-	-	3
PCC	ECC602	Artificial Intelligence	3	-	-	3	-	-	3
PCC	ECC603	Computer Networks	3	-	-	3	-	-	3
PCC	ECC604	Data Warehousing and Mining	3	-	-	3	-	-	3
OE	ECC65X	Professional Elective Course – II	3	-	-	3	-	-	3
PCCL	ECL606	Embedded Systems Lab	-	2			1		1
PCCL	ECL607	Artificial Intelligence and Computer Networks Lab	-	2	-	-	1	-	1
PCCL	ECL608	Data Warehousing and Mining Lab	-	2	-	-	1	-	1
PCCL	ECL609	Skill-based Laboratory:Linux Server Administration Lab	-	4	-	-	2	-	2
PCCL	ECL610	Mini Project 2B	-	4\$	-	-	2	-	2
			15	14	-	15	7	-	22

Examination Scheme – TE Semester-VI

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		IAT-1	IAT-2	Total					
ECC601	Embedded Systems and RTOS	20	20	40	60	2.5	-	-	100
ECC602	Artificial Intelligence	20	20	40	60	2.5	-	-	100
ECC603	Computer Networks	20	20	40	60	2.5	-	-	100
ECC604	Data Warehousing and Mining	20	20	40	60	2.5	-	-	100
ECC65X	Professional Elective Course – II	20	20	40	60	2.5	-	-	100
ECL606	Embedded Systems Lab	-	-	-	-	-	25	25	50
ECL607	Artificial Intelligence and Computer Networks Lab	-	-	-	-	-	25	25	50
ECL608	Data Warehousing and Mining Lab	-	-	-	-	-	25	25	50
ECL609	Skill-based	-	-	-	-	-	50	-	50

	Laboratory								
ECL610	Mini Project - 2B						25	25	50
Total				200	300	-	150	100	750

Department Level Optional Course - II:

ECC651. Machine Learning	ECC653. Digital Signal Processing
ECC652. Industrial Automation	ECC654. Electronic Product Design

Curriculum structure BE Sem-VII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECC701	VLSI Design	3	-	-	3	-	-	3
PCC	ECC702	Internet of Things	3	-	-	3	-	-	3
PCC	ECC73X	Professional Elective Course – 3	3	-	-	3	-	-	3
PCC	ECC74X	Professional Elective Course – 4	3	-	-	3	-	-	3
OE	OEC75WW	Open Elective - 1	3	-	-	3	-	-	3
PCCL	ECL706	VLSI Design Lab	-	2			1		1
PCCL	ECL707	Internet of Things Lab	-	2	-	-	1	-	1
PCCL	ECL78X	Professional Elective Course -3 Lab	-	2	-	-	1	-	1
MJP	ECL709	Major Project - I	-	4 #	-	-	2	-	2
	Total		15	10	-	15	5	-	20

Examination Scheme – BE Semester-VII

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract/ Oral	Total
		IAT 1	IAT2	Total					
ECC701	VLSI Design	20	20	40	60	2.5	-	-	100
ECC702	Internet of Things	20	20	40	60	2.5	-	-	100
ECC73X	Professional Elective Course – 3	20	20	40	60	2.5	-	-	100
ECC74X	Professional Elective Course – 4	20	20	40	60	2.5	-	-	100
OEC75 WW	Open Elective - 1	20	20	40	60	2.5	-	-	100
ECL706	VLSI Design Lab	-	-	-	-	-	25	25	50
ECL707	Internet of Things Lab	-	-	-	-	-	25	25	50
ECL78X	Professional Elective Course – 3 Lab	-	-	-	-	-	25	25	50
ECL709	Major Project - I	-	-	-	-	-	25	25	50
Total				200	300	-	100	100	700

Professional Elective Course – 3

Professional Elective Course – 3 (ECC73X)	
ECC731	1. Deep Learning
ECC732	2. Image Processing
ECC733	3. Big Data Analytics

ECC734	4. Advanced Database Management Systems

Professional Elective Course –4

	Professional Elective Course - 4 (ECC74X)
ECC741	1. Cloud Computing
ECC742	2. Mobile Communication
ECC743	3. Cyber Security
ECC744	4. Block chain Technology

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 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

Curriculum structure BE Sem-VIII

Course Type	Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
			L	P	T	L	P	T	Total
PCC	ECC801	Robotics	3	-	-	3	-	-	3
PCC	ECC82X	Professional Elective Course – 5	3	-	-	3	-	-	3
PCC	ECC83X	Professional Elective Course-6	3	-	-	3	-	-	3
OE	OEC84WW	Open Elective -2	3	-	-	3	-	-	3
PCCL	ECL805	Robotics Lab	-	2	-	-	1	-	1
PCCL	ECL86X	Department Level Optional Course - V Lab	-	2	-	-	1	-	1
MJP	ECL807	Major Project II	-	8#	-	-	4	-	4
	OJT899	Internship /On Job training					4		4
Total			12	12	-	12	10	-	22

Examination Scheme – BE Semester-VIII

Course Code	Course Name	Examination Scheme							
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)	TW	Pract\ Oral	Total
		IAT-1	IAT-2	Total					
ECC801	Robotics	20	20	40	60	2.5	-	-	100
ECC82X	Professional Elective Course – 5	20	20	40	60	2.5	-	-	100
ECC83X	Professional Elective Course-6	20	20	40	60	2.5	-	-	100
OEC84WW	Open Elective -2	20	20	40	60	2.5	-	-	100
ECL805	Robotics Lab	-	-	-	-	2.5	25	25	50
ECL86X	Professional Elective Course – 5 Lab	-	-	-	-	-	25	25	50
ECL807	Major Project II	-	-	-	-	-	50	100	150
OJT899	Internship /On Job training						25		
Total				160	240	-	125	150	675

indicates work load of Learner (Not Faculty), for Major Project Students group and load of faculty per week.

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

Professional Elective Course – 5

	Professional Elective Course – 5
ECC821	1. MEMS Technology
ECC822	2. Natural Language Processing
ECC823	3. 3-D Printing and Design
ECC824	4. Advanced Algorithms

Professional Elective Course – 6

	Professional Elective Course-6
ECC831	1. Advanced Networking Technologies
ECC832	2. Multimedia and Virtual Reality
ECC833	3. Quantum Computing
ECC834	4. System Security

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 both the semesters.

	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

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	Block chain 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						

Open Elective Scheme

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total
		L	T	P	L	T	P	SL	Notional Learning Hour	
	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	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)

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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F. E. Syllabus



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SEM I

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

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ECS-Semester-1

Theme: “Smart & Sustainable mechanism for Metropolitan Cities.”

Aligned with UNSDG Goals: -

- SDG 3: Good Health and Well-being
- SDG 4: Quality Education
- SDG 7: Affordable and Clean Energy
- SDG 9: Industry, Innovation, and Infrastructure
- SDG 11: Sustainable Cities and Communities

Keywords: Energy conservation, Water management, Waste handling, Environmental monitoring, efficient resource management in housing societies.

Description:

This semester's theme, "**Smart & Sustainable Mechanisms for Metropolitan Cities**," explores the integration of intelligent technologies and environmentally conscious practices to create efficient, resilient, and livable urban environments. It focuses on how electronics, computing, and applied sciences can be leveraged to address the complex challenges faced by large urban centers. This includes developing innovative solutions that optimize resource consumption "**Smart**" while ensuring long-term ecological balance and societal well-being "**Sustainable**". The theme aims to equip students with the skills to design systems that contribute to a higher quality of life, reduced environmental impact, and enhanced urban resilience in metropolitan areas.

Students will tackle real-world urban challenges such as energy conservation, water management, waste handling, environmental monitoring, and efficient resource management in housing societies. Through interdisciplinary projects, students will connect theoretical knowledge with practical applications, fostering early-stage engineering thinking and preparing them to develop impactful solutions for sustainable urban development.

Problem Statement:

1. Metropolitan areas like Mira Bhayandar face a major challenge with energy waste in common building areas (entrances, lobbies) due to continuously operating traditional lighting. This leads to high costs, light pollution, and a larger carbon footprint,



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Undermining urban sustainability. (UNSD Goal 11: Sustainable Cities and Communities)

2. Despite growing adoption of residential solar panels in metropolitan areas like Mira Bhayandar, homeowners lack affordable, real-time monitoring tools for DC power output. This prevents them from effectively tracking energy contribution, identifying inefficiencies, or valuing their clean energy, hindering informed energy management and devaluing renewable investments. (UNSD Goal 7: Affordable and Clean Energy)
3. Metropolitan areas like Mira Bhayandar face significant traffic congestion and safety issues due to inefficient traffic control systems. This leads to increased travel times, accident risks, and fuel consumption/emissions, undermining urban mobility, economic productivity, and overall smart/sustainable city development. (UNSD Goal 11: Sustainable Cities and Communities)
4. In metropolitan areas like Mira Bhayandar, urban air pollution in public parks poses an invisible threat. The lack of accessible, real-time air quality information prevents public awareness of health risks during outdoor activities, impacting public health and undermining sustainable urban living initiatives. (UNSD Goal 3: Good Health and Well-being)
5. In metropolitan areas, escalating parking demand leads to wasted time, fuel, and increased traffic congestion/emissions due to a lack of real-time occupancy information. This hinders efficient urban mobility and undermines smart, sustainable city infrastructure. (UNSD Goal 9: Industry, Innovation, and Infrastructure)
6. In dense metropolitan areas like Mira Bhayandar, homes and small businesses lack fundamental, low-cost security monitoring for entry points. This creates vulnerabilities to unauthorized entry, resulting in property loss, disruption, and a diminished sense of safety, as conventional systems are often too expensive or complex for smaller establishments. (UNSD Goal 11: Sustainable Cities and Communities)



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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	
13111101	Linear Algebra and Calculus	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13111101	Linear Algebra and Calculus	20	20	40	60	2.5	25	--	125

Rationale:

Mathematical concepts such as matrices, linear equations, eigenvalues, and eigenvectors are fundamental in modeling, analyzing, and solving engineering problems in Electronics and Computer Science. Matrices enable efficient data representation and manipulation critical to circuit analysis, digital signal processing, and computer graphics. Systems of linear equations frequently arise in electrical network design and algorithm optimization, allowing students to develop practical engineering solutions. Eigenvalues and eigenvectors play a key role in analyzing system stability, vibrations in electronic circuits,

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and dimensionality reduction techniques used in machine learning and data analysis. The principles of similarity and diagonalizability simplify complex matrix operations, making it easier to solve differential equations in control systems and signal processing. Partial differentiation helps analyze multivariable functions essential for optimizing device characteristics and tuning algorithms under varying conditions, which is crucial in electronics and software performance optimization. The study of analytic functions in complex variables provides powerful tools to model electromagnetic waves, signal propagation, and AC circuit behaviour, bridging theory with practical communication and computing applications. Together, these mathematical foundations equip Electronics and Computer Science students with the critical analytical and problem-solving skills necessary for understanding and innovating in their fields.

Course Objectives:

1. To understand matrix operations and their applications in engineering.
2. To formulate and solve systems of linear equations in engineering contexts.
3. To understand eigenvalues and eigenvectors in system analysis.
4. To understand matrix diagonalization for simplifying complex systems in filter design and digital signal processing (DSP).
5. To introduce partial differentiation for analyzing functions with multiple variables, common in electromagnetic field theory.
6. To understand analytic functions and their properties for applications in signal modulation and AC circuit analysis.

Course Outcomes:

1. Students will be able to apply matrix operations and use SCILAB to solve engineering problems such as circuit analysis and image processing.
2. Students will be able to solve systems of linear equations and use SCILAB to analyze electrical networks and optimize computer algorithms.
3. Students will be able to use eigenvalues and eigenvectors and use SCILAB to analyze stability in control systems and to perform data dimensionality reduction in computer science.



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4. Students will be able to diagonalize matrices and use SCILAB to simplify solving linear differential equations and enhance computational efficiency in signal processing.
5. Students will be able to apply partial differentiation and use SCILAB to optimize multivariable systems such as circuit parameters and algorithmic performance tuning.
6. Students will use analytic functions and use SCILAB to model and analyze electrical impedance and wave propagation in electronics and computer science.

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 numbers.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Matrices	Types of Matrices (Symmetric, Skew- symmetric, Hermitian, Skew-Hermitian, unitary, orthogonal matrices and properties of matrices). Rank of a matrix using Echelon form, reduction to normal form and PAQ form.(3X3) Application of matrices to Coding and De-coding.	05	CO1
		Self-learning Topics: 1. PAQ form for rectangular matrices. 2. Reduction to normal form. 3. Theorems on sum of symmetric and skew symmetric matrices and similar theorems. 4. Properties of transpose, conjugate of matrices	08	



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II	System of Linear Equations	System of linear homogeneous and non-homogeneous equations, their consistency and solutions using rank. 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.	05	CO2
		Self-learning Topics: 1. Vector Spaces 2. Linear Transformations. 3. Rank -Nullity theorems.	08	
III	Eigenvalues and Eigenvectors	Eigenvalues & Eigenvectors of all types of matrices (symmetric, skew symmetric, orthogonal, triangular) and its properties (without proof). Cayley-Hamilton Theorem (without proof), verification and reduction of higher degree polynomials.	05	CO3
		Self-learning Topics: 1. Quadratic forms. 2. Reduction to quadratic forms 3. Rank, signature and index of a quadratic form.	08	
IV	Similarity and diagonalization of matrix	Similar matrices, diagonalizable matrices, orthogonally diagonalizable matrices and functions of square matrix. Minimal polynomial, Derogatory and non-derogatory matrices. Singular value decomposition (SVD)	05	
		Self-learning Topics: 1. Functions of Square Matrix	07	



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		2. Orthogonally diagonalization.		
V	Partial Differentiation	Function of two and three variables, Partial derivatives of first and higher order. Differentiation of composite function. Maxima and Minima of a function of two independent variables. Lagrange's Multiplier method with one condition.	05	CO5
		Self-learning Topics: 1. Euler's Theorem on Homogeneous functions with two independent variables. 2. Euler's Theorem on Homogeneous functions with three independent variables. 3. Deductions from Euler's Theorem. 4. Total differentials 5. Implicit Functions	07	
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) 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.	05	CO6



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		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. 5. Separation of real and imaginary parts of all types of Functions.	07	
	Total		75	

Text Books:

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

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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.



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7. Wylie C. R, Barrett L.C.: “Advanced Engineering Mathematics” McGraw Hill Book Co., New York, 6th Ed., 2017.
8. Ramana B.V.: “Higher Engineering Mathematics”, Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
9. Gupta C.B, Sing S.R and Mukesh Kumar: “Engineering Mathematics for Semester I and II”, Mc- Graw Hill Education, 2015.
10. Lay D. C: “Linear Algebra and its Applications”, Pearson Publishers, 4th Ed., 2018.
11. 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/
4.	https://archive.nptel.ac.in/courses/111/104/111104092/



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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	
13111102	Basics of Semiconductor Physics	2	--	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
13111102	Basics of Semiconductor Physics	20	20	40	60	2.5	--	--	100

Rationale:

The syllabus for Electronics and Telecommunication Engineering (EXTC) and Electronics and Computer Science (ECS) branches is structured to provide a strong theoretical and practical foundation in semiconductor physics, electronic devices, circuit analysis, and emerging technologies. Core topics such as diodes, transistors, FETs, and nanotechnology are included to help students understand the working principles of modern electronic systems. The inclusion of device applications and modern trends like MOSFETs and Hall Effect ensures students are aligned with current industry practices and prepared for advanced studies in communication systems, embedded electronics, and computational electronics.



Course Objectives:

1. To introduce the fundamental concepts of semiconductors and carrier behaviour in intrinsic and extrinsic materials.
2. To explain the working principles and characteristics of p-n junction diodes.
3. To familiarize students with the construction, types, and applications of special-purpose diodes.
4. To study the operation, characteristics, and switching behaviour of Bipolar Junction Transistors (BJTs).
5. To understand the structure, functioning, and application of Field Effect Transistors (JFETs and MOSFETs).
6. To introduce nanotechnology concepts, material properties at the nanoscale, and their applications in electronics.

Course Outcomes:

1. **EXPLAIN** how charge carriers behave in intrinsic and extrinsic semiconductors and **CALCULATE** their concentrations using basic formulas.
2. **DESCRIBE** how a p-n junction is formed, **DERIVE** the diode equation, and **ANALYZE** how current and voltage change in different bias conditions.
3. **CLASSIFY** different special-purpose diodes and **EXPLAIN** how they work and where they are used.
4. **INTERPRET** how BJTs work in different circuits and **EXPLAIN** their role in amplification and switching.
5. **COMPARE** JFET and MOSFET structures and **APPLY** MOSFETs in simple switching applications.
6. **SUMMARIZE** the basics of nanotechnology and **IDENTIFY** how it's used in making modern electronic devices.

**DETAILED SYLLABUS:**

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Basic understanding of atomic structure and energy bands in solids Knowledge of conductors, insulators, and semiconductors Familiarity with Ohm's Law, resistance, and electrical circuits Concept of current, voltage, power, and energy in electrical systems Basic idea of magnetic fields and electromagnetic induction		
1	Introduction to Semiconductors	Direct and Indirect Semiconductors, Carrier Concentration in Intrinsic Semiconductors, Fermi Level of Intrinsic Semiconductors, Variation of Fermi Level of Intrinsic Semiconductors with respect to Temperature, Extrinsic Semiconductors, Fermi Level of Extrinsic Semiconductors, Variation of Fermi Level of Extrinsic Semiconductors with respect to Temperature and Impurity Concentration, Equation of Conductivity with Current Flow, Hall Effect, Calculation of Hall Voltage.	14	CO1
		Self-Learning: Energy band diagrams of metals, insulators, and semiconductors Drift current and diffusion current in semiconductors Applications of Hall Effect in sensor design and material characterization	14	



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		Real-life examples of intrinsic and extrinsic semiconductors (e.g., Silicon, Germanium, GaAs), Basics of semiconductor material fabrication (crystal growth, doping techniques)		
2	Junction Diode Physics and Characteristics	Formation of p-n junction, calculation of barrier potential Diode equation, p-n junction in forward Bias, p-n junction in Reverse bias, Current-voltage curve for p-n junction diode, Derivation of barrier potential.	16	CO2
		Self-Learning: Breakdown mechanisms in p-n junctions: Zener and Avalanche breakdown Diode dynamic (AC) resistance and static (DC) resistance Capacitance effects in p-n junctions (transition and diffusion capacitance) Applications of diodes in logic circuits and voltage multipliers.	16	
3	Functional Diodes and Optoelectronic Devices	Study of concept and working of various important diodes such as Zener diode, Light Emitting Diode (LED), Photodiode, Solar Cell, Varactor diode, Gunn diode, Tunnel diode, Schottky diode, PIN diode, Avalanche diode, Laser diode, Shockley diode, and Step Recovery diode.	03	CO3
		Self-Learning: Material science behind LED color variations (bandgap and emission spectrum), photodiode response time and noise characteristics, applications of varactor diodes in frequency modulation and tuning circuits, negative resistance property in Gunn and Tunnel diodes, PIN	03	



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		diode usage in RF attenuators and switches, use of avalanche diodes in ESD (Electrostatic Discharge) protection circuit.		
4	Transistor Operation and Applications	BJT Structure and Operation - BJT structure, Modes of operation, CE I-V characteristics BJT Amplification and Switching - Current gain, BJT as a switch.	03	CO4
		Self-Learning: Configurations (CB, CE, CC) and their comparisons, load line analysis and Q-point stability, transistor biasing techniques and their practical importance BJT switching speed and delay factors, real-life applications of BJT in amplifier and logic circuits.	03	
5	Field Effect Transistors	Field Effect Transistors – Introduction to FETs, types of FETs: JFET and MOSFET, structure and operation. Detailed study of MOSFETs – MOSFET structure, enhancement mode and depletion mode operation, threshold voltage. Applications of MOSFET – MOSFET as a switch.	04	CO5
		Self-Learning: Comparison between JFET and MOSFET characteristics, graphical analysis of transfer and output characteristics of FETs, significance of threshold voltage in switching applications, CMOS basics and role of MOSFETs in CMOS logic circuits.	04	
6	Nanotechnology	Introduction to Nanotechnology, Properties (optical, Electrical, Structural, Mechanical) Importance of surface to Volume ratio, nanofabrication techniques such as chemical vapor deposition, Application: Lithography, Single	05	CO6



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		Electron Transfer (SET), Spin Valves.		
		Self-Learning: Difference between bulk and nanoscale materials, effect of reduced dimensions on physical properties, classification of nanomaterials (0D, 1D, 2D, 3D), role of quantum confinement in optical and electrical behavior of nanomaterials, real-world applications of SET and spintronics devices, basics of nanolithography and its use in semiconductor industries.	05	
	Total		60	

Text Books:

1. Engineering Physics by D.K Bhattacharya, Poonam Tandon - Oxford University Press
2. Solid State Electronic Devices – B. G. Streetman – Pearson
3. Electronic Devices and Circuits – Thomas Floyd – Pearson
4. Electronic Devices and Circuits – David A. Bell – Oxford University

References:

1. Semiconductor Physics and Devices – Basic Principles – Donald Neamen – McGraw Hill
2. Physics of Semiconductor Devices - S.M. Sze, Kwok K. Ng - John Wiley & Sons
3. Electronic Devices and Circuit Theory - R. Boylestad, L Nashelsky - Pearson

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/108/108/108108122/
2.	https://onlinecourses.nptel.ac.in/noc22_ee97/preview
3.	https://www.optima.ufam.edu.br/SemPhys/Downloads/Neamen.pdf



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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	
13121103	Basic Electrical and Electronics Engineering	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 2	Total.					
13121103	Basic Electrical and Electronics Engineering	20	20	40	60	2.5	--	--	100

Rationale: This course provides foundational knowledge of electrical and electronic principles essential for all engineering disciplines. It covers basic circuit theory, electrical machines, and electronic components like diodes, transistors. Understanding these fundamentals enables

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students to analyze and troubleshoot simple electrical systems and prepares them for advanced topics in automation, communication, and embedded systems. The course supports interdisciplinary learning and develops essential problem- solving skills for real-world engineering applications.

Course Objectives:

1. To enable students to **understand** the fundamental concepts of direct current (DC) circuits, including Ohm's Law, Kirchhoff's Laws, and basic circuit components, and apply them to analyze and solve simple electrical networks.
2. To enable students to **explore** the principles of alternating current (AC) in single-phase and three-phase circuits, including the concepts of RMS value, power factor, and power measurement.
3. To enable students to **identify** the construction, working principle, and applications of a single-phase transformer, along with its efficiency
4. To enable students to **relate** the principles of electromagnetic induction to the operation of various electrical machines like DC machines, induction motors
5. To enable students to **promote** understanding of the working principles and applications of semiconductor devices like diodes and transistors, and their role in amplifier circuits.
6. To enable students to **encourage** to understand the basics of digital systems, including number systems and logic gates, to build a strong foundation in digital electronics

Course Outcomes:

1. **Apply** Ohm's Law, Kirchhoff's Laws, and network theorems like Thevenin's, Norton's, and Superposition to analyze DC circuits in electronic systems
2. **Analyze** single and three-phase AC circuits using phasor diagrams, impedance, and power factor to evaluate voltage, current, and power in various configurations.
3. **Explain** the construction, working principle, and equivalent circuit of a single-phase transformer, including its performance parameters such as efficiency
4. **Illustrate** the construction, working principles, and applications of basic electrical machines such as DC machines and AC motors.
5. **Evaluate** the characteristics and applications of semiconductor devices such as PN junction diode, Zener diode, and BJT in electronic circuits.
6. **Demonstrate** the operation of basic digital circuits using logic gates, Boolean algebra.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Resistance, inductance, capacitance, series and parallel connection of resistance, concept of voltage, current, power and energy and its units, magnetic circuit, mmf, magnetic field strength, reluctance.		
1	DC Circuits	D.C. circuits and network simplification: series and parallel circuits, Kirchhoff's laws, mesh and nodal analysis. star-delta transformation, Mesh and Nodal Analysis, Source transformation Superposition theorem, Thevenin's theorem, Norton's theorem, maximum power transfer theorem	14	CO1
		Self Learning: Basic electrical quantities: voltage, current, resistance, and power. Ohm's Law, Kirchhoff's laws, and sign conventions Algebra and solving linear equations, basic network terms (node, branch, loop)	14	
2	AC circuits (Single phase and Three Phase system)	Generation of alternating voltage & current (AC), fundamentals of AC - waveforms, Phasor representation of AC quantities, definitions of time period, amplitude, frequency, phase, RMS value and average value, Peak factor and Form Factor. R, L, C in AC circuits, Series RL, RC and RLC circuits- phase difference and power factor, phasor diagram, series-parallel circuits, active, reactive, apparent power, series resonance.	16	CO2



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		Generation of three-phase voltages, voltage & current relationships in star and delta connections.		
		Self Learning: AC Waveforms & Parameters – Sine wave, frequency, time period, amplitude Phasor Representation – Vector form of AC quantities RMS & Average Values – Definitions, formulas, practical significance Peak Factor & Form Factor – Understanding waveform shapes	16	
		Working principle of single-phase transformer, emf equation of a transformer, transformer losses, actual (practical) and ideal transformer, overview of efficiency	03	
3	Single Phase Transformers	Self Learning: Working principle and EMF equation of a transformer Transformer losses: core and copper losses Ideal vs. practical transformer. Transformer efficiency and load conditions. Role of transformers in power systems.	03	CO3
4	Electrical Machines	Construction, principle of operation, classification of DC machines, applications of DC generator, DC motor, equation of generated emf/back emf Fundamental principles of rotating machines, construction, working principle and application of stepper and servo motor	03	CO4



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		Self Learning : Construction, operation, and classification of DC machines EMF and back emf equations in DC machines Basics of rotating machines Stepper and servo motors: construction, working, applications	03	
5	Semiconductor Devices	Semiconductor Basics, Construction, operation and characteristics of PN junction diode, zener diode and bipolar junction transistor.	04	CO5
		Self Learning Semiconductor fundamentals: types and properties PN junction diode: construction, operation, and I-V characteristics Zener diode: construction, operation, and voltage regulation Bipolar Junction Transistor (BJT): structure, working, and characteristics	04	
6	Fundamentals of digital circuits	Number System: Binary, octal, decimal, hexadecimal, their conversion, and arithmetic (binary addition, subtraction using 1's & 2's complement) Logic Gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR universal gates. Boolean algebra, DE Morgan's theorem	05	CO6
		Self Learning: Number systems and conversions Binary addition and subtraction (1's & 2's complement) Boolean algebra basics	05	
	Total		90	



Text Books:

1. B. L. Theraja – Textbook of Electrical Technology, Prentice Hall of India (PHI)
2. B.R Patil – Basic Electrical Engineering, Oxford Higher Education
3. V. N. Mittal and Arvind Mittal – Basic Electrical Engineering, Tata McGraw Hill
4. V. K. Mehta – Principles of Electronics, S. Chand Publishing, New Delhi 7
5. R. S. Sedha – A Textbook of Applied Electronics, S. Chand Publishing, New Delhi
6. Digital Fundamental, 8th edition, Floyd and Jain, Pearson Education India, 2005
7. Electric Motors and Drives Fundamentals, Types and Applications, 3 rd Edition, Austin Hughes, Newnes Publisher.

References:

1. Introduction to Electrical Engineering, M. Naidu, S. Kamakshaiah, McGraw-Hill Education, 2004
2. S. N. Singh, “Basic Electrical Engineering” PHI, 2011
3. Electrical and Electronic Technology, 10th edition Edward Hughes, Pearson Education.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/108108076
2.	https://www.nesoacademy.org/ec/04-analog-electronics/02-semiconductor-diode/01-p n-junction-diode-no-applied-bias
3.	https://onlinecourses.nptel.ac.in/noc21_ee55/preview
4.	https://onlinecourses.nptel.ac.in/noc20_ee60/preview
5.	https://archive.nptel.ac.in/courses/108/105/108105113/



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		L	T	P	L	T	P	SL	Notional Learning Hour	
13121104	Engineering Graphics & Design	2	-	-	30	-	-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
13121104	Engineering Graphics & Design	20	20	40	60	2.5	--	--	100

Rationale:

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

Course Objectives

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

Course Outcomes

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

Module no.	Module Name	Detailed content	Teaching hours	CO
	Prerequisite	To draw basic geometric shapes like circle, pentagon, hexagon, and square with different orientation.	01	
		Divide a line, circle, etc. into equal number of parts.		



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1	Introduction to Engineering Drawing and Engineering curves	Introduction to Engineering Graphics and its significance in the Engineering domain. Types of Lines, Dimensioning Systems as per IS conventions. Engineering Curves: Basic construction of Conics, Cycloid, Involute and Helix (cylinder only).	03	CO1
		Self-learning topic: - Explore the concepts of eccentricity, focus, vertex, axis, directrix - Explore other conics - ellipse, parabola and hyperbola using directrix-focus method	03	
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.	05	CO2
		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	
3	Projections of Solids	3.1 Projections of solids with the axis inclined to one reference plane include prism and cylinder 3.2 Projections of solids with the axis inclined to both reference planes include pyramid, and cone (Use change of position or Auxiliary plane method)	06	CO3



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		Self-learning topic: - Explore the cuboid and tetrahedron solids inclined to one or both the reference planes. - Explore the applications of solid projection in machine components, structure, and packaging and manufacturing.	06	
4	Sections of Solids and Development of Surfaces	Sections of Solids Sections of Prism, Pyramid, Cylinder, & Cone cut by plane perpendicular to only one reference plane. Use change of position or Auxiliary plane method..	04	CO4
		Self-learning topics: - Explore the development of lateral surface for regular solids - Prism, Pyramid, Cylinder, & Cone - Explore the real-life application of solids cut with section planes inclined to one plane	04	
5	Orthographic and Sectional Orthographic Projections	Fundamental concepts of orthographic and sectional orthographic projections like Positioning of quadrants, observer, horizontal, vertical and profile plane, symbol etc., Different orthographic views, First and Third angle method of projection, different section (cutting) plane, its representation, importance of sectional views, rib and web in section. Views of simple machine parts as per the first angle projection method recommended by I.S. for Orthographic and Sectional Orthographic projection	06	CO5
		Self-learning topics: - Explore the third angle method of projection for orthographic views. - Explore half sectional and offset sectional views - Practice simple machine components with half section and offset section	06	



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6	Isometric Views	Introduction to isometric projections and Fundamental concepts of Isometric projection - isometric and non-isometric lines, axes, and planes. Concept of isometric scale. Difference between isometric projection and isometric views. Conversion of orthographic views to isometric views	05	CO6
		Self-learning topics: - Explore the concepts of isometric scale and isometric projection - Practice isometric projection of simple objects using isometric scale - Explore the isometric views and projections of holes and slots on an inclined plane	05	
Total				

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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		L	T	P	L	T	P	SL	Notional Learning Hour	
13121105	C and C++ Programming	3	--	--	45	--	--	45	90	3

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Prac tical/ Oral	Total
		Internal Assessment Test (IAT)			End Sem Exam	Exam Duration in Hrs.			
		IAT -I	IAT- II	(Total)					
13121105	C and C++ Program ming	20	20	40	60	2.5	--	--	100

Rationale:

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

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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.



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

Prerequisite: Nil.

Detailed Syllabus:

M. No.	Module Name	Detail Topics	Hours	CO Mapping
0	Prerequisite	• Basic familiarity with fundamental mathematical and logical reasoning skills. • Understanding of basic computer operations – such as using a keyboard, mouse, operating systems, and file handling. • Logical thinking and problem-solving ability – including flowcharting, algorithmic thinking, and basic decision-making. • Basic English comprehension skills – to read and write code, understand syntax, and follow programming logic.	--	--



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		• Program Development Life Cycle (PDLC) - Structure of a C Program, Compilation, Execution • Concepts of Structured Programming in C • 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(), fgets(), 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	CO1



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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/Reference • Storage Classes, 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	CO2
		Self-Learning Topics: • Sorting an array, Binary searching • Declaration and Initialization of a Multidimensional Array • Matrix addition, multiplication • Arrays of strings: Two-dimensional character array • Passing Arrays to Functions • Character manipulation in the String using character functions in <ctype.h> • Implement recursive solutions (e.g., Fibonacci, Tower of Hanoi) • Comparison of recursion and iteration (mini presentation) • Industry application: Use of arrays/strings in data processing	8	CO2
3	Pointers, Structures, and File Handling	• Pointers: Basics, address operator(&), Declaring & initializing Pointer Variables, Indirection Operator and Dereferencing, Pointer Expressions	7	CO3



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		and Pointer Arithmetic, Types of Pointers, Pointer to Pointers, Pointers and Arrays • Dynamic Memory Allocation (malloc, calloc, realloc, free) • Structures and Unions, Declaring Structures and Structure Variables, Accessing the members of a structure, Initialization of Structures, Copying and comparing Structures, typedef, Nested Structures, Arrays of Structures, Arrays within the Structure, Structures and Functions • Files: File operation- Opening, Closing, Creating, Reading, File Modes, File I/O Functions, Processing text Files.		
		Self-Learning Topics: • Call by address using pointers, returning more than one value from a function, returning pointer from a function, structures and pointers, • 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	CO3
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	CO4



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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	CO4
5	Advanced OOP Concepts (C++)	Polymorphism: Overloading Operators, Operator Overloading using Friend Function, Function Overloading and Compile Time Binding Inheritance: Creating a Parent-Child relationship between Classes, Types of Inheritance, Implementing Multilevel and Hybrid Inheritance, Virtual Base Class, Function Overriding - Virtual functions and runtime polymorphism - Pure Virtual Functions and Abstract Classes, Interfaces - Function Overloading vs Function Overriding	8	CO5
		Self-Learning Topics: - Working of Constructors with Multiple Inheritance Creating a "String" data type – An example using Operator and function overloading - Create inheritance-based applications (e.g., employee hierarchy system) - Mini project proposal based on OOP concepts - Read and summarize advanced topics like Templates or Exception Handling	8	CO5



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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	CO6
		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	CO6

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.

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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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		L	T	P	L	T	P	SL	Notional Learning Hour	
13112106	Basics of Semiconductor Physics Lab	--	--	1	--	--	15	--	15	0.5

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13112106	Basics of Semiconductor 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 understand the physical significance of the gradient, divergence, and curl operators in vector calculus through simple examples.
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:

1. Learners will be able to RELATE the foundations of quantum mechanics with the development of modern technology.
2. Learners will be able to DETERMINE the wavelength of light and EXPLAIN the interference phenomenon.
3. Learners will be able to ILLUSTRATE the use of lasers in applications and APPLY the fundamentals of fiber optics in modern communication technology.
4. Learners will be able to use a computational tool (e.g., **MATLAB** or **Python**) for CALCULATING the gradient, divergence, and curl of predefined fields.
5. 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.
6. Learners will be able to have a fundamental UNDERSTANDING of semiconductors, including their properties, types, and applications in basic engineering.

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

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06	Physical Significance of Gradient, Divergence, and Curl	01	LO4
07	Study of Hall Effect.	01	LO5
08	Measurement of Distance using Ultrasonic Distance Meter.	01	LO5
09	Study of I-V characteristics of Photodiode	01	LO6
10	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/

Assessment:

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



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		L	T	P	L	T	P	SL	Notional Learning Hour	
13122107	Basic Electrical and Electronics Engineering Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
13122107	Basic Electrical and Electronics Engineering Lab	-	-	-	-	-	25	25	50

Pre-requisite: Fundamentals of Physics and Mathematics



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Lab Objectives:

Lab course aims to

1. To impart the basic concept of network analysis and its application
2. To provide the basic concept of AC circuit analysis and its application
3. To illustrate the operation of the transformer and machines
4. To demonstrate the behavior and application of special purpose diodes and transistors.
5. To implement and analyze transistor configuration
6. To introduce logic gates

Lab Outcomes:

1. Apply and experimentally verify various network theorems in DC circuits to analyze and simplify electrical networks.
2. Perform experiments on AC circuits to evaluate power factor and analyze phase relationships between voltage and current.
3. Demonstrate transformer operation and identify practical applications
4. Illustrate the performance and applications of motors in automation and peripheral devices.
5. Implement and analyze diode behavior.
6. Demonstrate basic logic gates and implement them using universal gates.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	Fundamental Mathematics and Physics		
1	Introduction to Laboratory Safety and Usage of Electrical Measuring Instruments	2	LO1
2	Verification of Mesh and Nodal analysis.	2	LO1



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3	To verify the equivalence between Star and Delta networks.	2	LO1
4	Verification of DC network Theorems (Superposition, Norton's and Thevenin's)	2	LO1
5	To verify the equivalence of a Voltage Source in series with resistance and a Current Source in parallel.	2	LO1
6	Measurement of electrical parameters for alternating sinusoidal voltage (AC)	2	LO2
7	To calculate and compare Measurement of Active, Reactive and Apparent Power in AC Circuit	2	LO2
8	Observe three-phase voltage relationships in star and delta connections using simulation tools.	2	LO2
9	To simulate and analyze the performance of single-phase transformer	2	LO3
10	Study of DC machines	2	LO4
11	Forward & reverse bias characteristics of PN junction diode	2	LO5
12	Observe LED behavior and test various LED configurations for digital indicators.	2	LO5
13	Construct a BJT-based switch circuit	2	LO5
14	Study of application of Zener diode as Voltage Regulator	2	LO5
15	To simulate the implementation of Basic logic gates using universal gates	2	LO6

Online Resources:

Sr. No.	Website Name
1.	https://www.allaboutcircuits.com/
2.	https://www.tinkercad.com/
3.	https://www.circuitlab.com/

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Sr No	List of Assignments / Tutorials	Hrs
1	Application and Analysis of DC Network Theorems: A Study through Theoretical Concepts and Numerical Problems	2
2	Comparative Analysis of DC Network Theorems and Their Extension to Single and Three-Phase AC Circuits: A Theoretical and Numerical Approach	2
3	Theoretical Understanding of Single-Phase Transformers: Principles, Construction, and Role in Modern Power Systems	2
4	Theoretical Insights into Electrical Machines: Working Principles, Construction, and Applications in Modern Industry	2
5	Industrial Applications of Semiconductor Devices: A Study on Diodes and Transistors in Power and Communication Systems	2
6	Design and Application of Basic Digital Circuits: A Study on Logic Gates, Boolean Algebra, and Real-World Implementations	2
7	Case Study 1: Integrated Power System Design: Analysis of DC and AC Circuits with Single-Phase Transformers and Electrical Machines for Smart Residential Applications	2
8	Case study 2: Application of Semiconductor Devices and Digital Electronics in Industrial Automation and Control of Electrical Machines	2

Assessment:

Term Work: Term Work shall consist of at least 8 to 10 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 exam will be held based on the above syllabus.



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		L	T	P	L	T	P	SL	Notional Learning Hour	
13122108	Engineering Graphics & Design Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
13122108	Engineering Graphics & Design 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.
- 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 / Tutorials	Hrs	CO mapping



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

Term Work Marks: 25 Marks (Total marks) = 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	
13122109	C and C++ Programming Lab	--	--	2	--	--	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT 2	Total				
13122109	C and C++ Programming 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, storage classes, and arrays, enhancing their understanding of



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data management.

3. To familiarize students with advanced C programming concepts such as structures, pointers, dynamic memory allocation, and file handling for effective data storage and manipulation.
4. To provide comprehensive exposure to object-oriented programming in C++ focusing on classes, objects, constructors, destructors, friend functions, and function/operator overloading.
5. To deepen understanding of advanced object-oriented concepts in C++ including inheritance, polymorphism, virtual functions, and abstract classes for designing flexible software solutions.
6. To guide students in designing and implementing an object-oriented system in C++ that integrates key programming concepts for practical application.

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

1. **Analyze and apply** fundamental programming constructs in C using Code::Blocks IDE to develop, compile, debug, and execute programs that implement input/output operations, operators, and control flow structures such as branching, looping, and nested decisions.
2. **Apply and evaluate** the use of functions, recursion, storage classes, 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, and file handling to manage and persist complex data efficiently in real-world applications.
4. **Apply and analyze** core object-oriented programming concepts in C++ including classes, objects, constructors/destructors, friend and inline functions, and implement polymorphism through function and operator overloading 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.

*R-2025- F.E. (Sem I) Electronics and Computer Science***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	a) Program to demonstrate Branching - If statement, If-else Statement, Multiway decision. b) Program to demonstrate Looping – while, do-while, for	2
04	Program to demonstrate Nested control structure- Switch statement, Continue statement, Break statement, Goto statement	2
05	Program to demonstrate Function, Passing Arguments to a Function (call by value and call by reference).	2
06	a) Implement an iterative function for factorial/ Fibonacci etc. b) Implement a recursive function for factorial/ Fibonacci etc.	2
07	Program to demonstrate Storage Classes –Auto, Extern, Static, Register.	2
08	Program to demonstrate Array 1D and Array 2D.	2
09	Program to demonstrate String and arrays of string.	2
10	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
11	Implementation of Pointers, Pointer Arithmetic, and Dynamic Memory Allocation in C	2
12	Program to demonstrate files: Write a program to maintain a simple student/employee etc. database using file handling. a) Open a file to store student records, b) Implement functions to add, update, and display records. c) Ensure data persistence by saving changes to the file.	2

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13	Program to demonstrate the use of classes and objects, constructors and destructors in C++ and implementation of Friend functions and inline functions, Array of objects	2
14	Program to demonstrate function overloading and operator overloading	2
15	a) Program to demonstrate Single, multilevel, and hybrid inheritance using classes b) Virtual functions and runtime polymorphism	2
16	Program to demonstrate use abstract classes and interfaces (pure virtual functions)	2
17	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



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03	Structures, pointers with dynamic memory allocation, and file handling	2
04	Core object-oriented programming concepts in C++	2
05	Advanced object-oriented programming concepts in C++ including various inheritance types, virtual functions for runtime polymorphism, and abstract classes with pure virtual functions	2
06	C++ object-oriented program that models an object-oriented system by applying advanced concepts for efficient data handling and processing	2

Text Books

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

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



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Online Resources:

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

Assessment:

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



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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	
13122110	IDEA LAB - I (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 I	IAT-2	Total				
13122110	IDEA LAB - I (Innovation Design Engineering and Apply	--	--	--	--	50	50	100

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



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

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

2) Implementation Strategy

a) Project Implementation in IDEA Lab

Aspect	Implementation Strategy
Faculty in-charges	Faculty in-charges assigned based on project nature and department capacity.
Mentoring Role	Faculty in-charges oversee academic/technical development, interdisciplinary integration, and timely documentation.
Capacity Building	Faculty in-charges undergo workshops on design thinking, innovation, assessment rubrics, and outcome-based mentoring.
Assessment Contribution	Recognition & Incentives

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Faculty in-charges contribute to 25 marks allocated for the IDEA Lab project termwork. The remaining assessments are conducted by the external examiner.

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



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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

*R-2025- FE(Sem I) Electronics and Computer Science***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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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	
13412111	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-I	IAT-II	Total				
13412111	Workshop I	--	--	--	--	25	—	25

Lab Objectives:

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

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features in Microsoft Excel.

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

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

Detailed Syllabus

Sr No	Name of Module	Detailed content	Hours	Lo
1	Introduction to PCB	Electronic Components and tools for measuring and debugging electronics circuits. ● Active and Passive components ● Breadboard to built simple circuits. ● Soldering Practices. ● Reading and interpreting circuit diagrams ● Multimeter ● Oscilloscope 8050 and DS0 ● Function generator ● Logic Probe/logic analyzer (demo) PCB Design and fabrication ● Wiring system ● Go-down wiring ● House Wiring ● Staircase wiring ● Introduction To PCB design Software ● Drawing a simple schematic ● PCB layout and routing techniques.	6 6	LO1,L02
		Self- Learning 1. Component Identification and Research (real –life example). 2. Resistor Color Code Practice (learn	5	

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		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.



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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

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

Suggested list of Experiments:

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	
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	Total					
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 Technology in India.		

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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 Governance about Ramayana, Mahabharat, Artha Sastra and Kauṭilyan State,Scientific Explanation of Vedic or traditional system of society for Good Governance	5	CO6

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		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 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 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.)
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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
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SEM II

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ECS-Semester-II

Theme: “Connected Communities through Intelligent Systems and Sustainable Design.”

Aligned with UNSDG Goals: -

- **UNSDG 3:** Good Health and Well-being
- **UNSDG 6:** Clean Water and Sanitation
- **UNSDG 7:** Affordable and Clean Energy
- **UNSDG 9:** Industry, Innovation and Infrastructure
- **UNSDG 11:** Sustainable Cities and Communities
- **UNSDG 16:** Peace, Justice, and Strong Institutions

Keywords: Digital entry system, FSM (Finite State Machine), Keypad access, Affordable security, Residential automation, Community safety, Sustainable Cities

Description:

The theme "**Connected Communities through Intelligent Systems and Sustainable Design**" emphasizes the development of low-cost, scalable technologies that foster smarter and more inclusive suburban living. In suburban areas across Mumbai—such as Mira Road, Dombivli, Vasai, and Kurla communities face everyday challenges ranging from insecure entry systems in housing societies, to unmanaged traffic signals, water overflow in tanks, and food wastage in schools and hostels. These localized issues, often overlooked, stem from a lack of simple, tech-enabled solutions rooted in community needs. By integrating digital logic, sensor-based automation, and Python-driven control systems, students work toward solving these real-world problems. This theme directly supports UN Sustainable Development Goals focused on clean energy, sustainable cities, quality education, clean water, and community well-being—driving engineering practice toward socially responsible innovation.

Problem Statements:

1. In many densely populated suburban and urban areas, residential communities often lack automated entry systems. Manual gate operations and the high cost of commercial security solutions pose challenges for these neighborhoods in adopting modern and efficient security measures.



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2. Intersections in many suburban and urban areas often experience traffic congestion and safety issues due to outdated or manually operated traffic control systems. This results in irregular traffic flow, longer commute times, and a higher risk of accidents.
3. In areas with unreliable electricity supply, such as Vasai and Nalasopara, streetlights are frequently left on during daylight hours due to the lack of automated control systems. This results in unnecessary energy wastage and higher maintenance and operational costs.
4. In many urban neighborhoods, overflow from overhead water tanks is a common problem, causing substantial water wastage and potential structural damage due to dampness.
5. Educational institutions in many areas struggle to maintain timely class schedules due to dependence on manual bell systems. This often leads to time mismanagement and interruptions in the academic routine.
6. In many suburban regions, students who commute by bicycle often encounter a lack of secure parking facilities on educational campuses. The absence of proper locking infrastructure raises the risk of theft and discourages the use of environmentally friendly transportation options.



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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	
13111201	Probability, Statistics, and Differential Equations	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13111201	Probability, Statistics, and Differential Equations	20	20	40	60	2.5	25	--	125

Rationale

This course equips first-year Electronics and Computer Science Engineering students with fundamental mathematical concepts and techniques essential for their engineering studies. Beginning with differential equations, students learn to model and analyze dynamic systems commonly encountered in electronics and computing. The topic of double integrals introduces the ability to evaluate multi-dimensional quantities relevant to physical and computational problems. Incorporating probability distributions and statistics, the course enables students to handle randomness and analyze data effectively, which is vital in fields like communication systems, machine learning, and system

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performance evaluation. The section on statistical techniques develops skills in inference and decision-making using real-world data. Lastly, the course covers numerical methods that provide computational tools to approximate solutions to complex mathematical problems, supporting simulation, algorithm design, and optimization in engineering applications.

Overall, this course lays a strong foundation by blending theory and application, preparing students for advanced topics and practical challenges in Electronics and Computer Science Engineering. 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 modeling and solving differential equations for engineering applications.
2. To teach evaluation of double integrals for multi-dimensional engineering problems.
3. To introduce key probability distributions for modeling uncertainty in engineering systems.
4. To develop skills in summarizing and interpreting engineering data sets.
5. To introduce inferential statistical methods for data-driven engineering decisions.
6. To equip students with numerical techniques for computational problem solving.

Course Outcomes:

1. Students will be able to solve differential equations and use SCILAB to model circuits and dynamic processes.
2. Students will be able to evaluate double integrals and use SCILAB to calculate physical quantities and data distributions.
3. Students will be able to apply probability distributions and use SCILAB to analyze noise and error rates.



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- Students will be able to interpret and use SCILAB statistical data to assess system performance and reliability.
- Students will be able to analyze data and use SCILAB using hypothesis testing and regression techniques.
- Students will be able to implement and use SCILAB numerical methods to approximate solutions in simulations and algorithms.

Prerequisite:

- Basics of integration and its properties.
- 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.	10	



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		4. Legendre's differential equation. 5. Applications of first order and first degree and also Higher order differential equation.		
II	Multiple Integrals	Beta and Gamma functions and its properties.	05	CO2
		Double integration-definition, Evaluation of Double Integrals. (Cartesian & Polar)		
		Change the order of integration (No Evaluation)		
		Self-learning topics: 1. Rectification of curves. (Cartesian, Polar and Parametric) 2. Application of double integrals to compute Area and Mass of lamina.	10	
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	10	



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		3. Decision Theory		
V	Statistical Techniques	Spearman's Rank correlation coefficient (R) (with repeated and non-repeated ranks)	05	CO5
		Lines of regression		
		Fitting of first- and second-degree curves.		
		Self-learning Topics: 1. Karl Pearson's Coefficient of correlation(r). 2. Fitting of exponential curve. 3. Fitting of logarithmic curve. 4. Covariance 5. Sampling theory for quantitative and qualitative samples.	10	
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.

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2. Fundamentals of Statistics, S. C. Gupta.
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa.
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2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
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4. Engineering Optimization: Theory and Practice, S.S Rao, Wiley-Blackwell

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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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		L	T	P	L	T	P	SL	Notional Learning Hour	(Notional Learning Hour/30)
13111202	Engineering Chemistry for Electronics	2	-	--	30	--	--	30	60	2

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Durat ion (in Hrs)			
		IAT1	IAT2	Total					
13111202	Engineering Chemistry for Electronics	20	20	40	60	2.5	--	--	100

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Rationale:

1. Chemical science has contributed in many ways to most of the Engineering branches where “Applied Chemistry” is the modern approach to learn impact of Technology on habitat and can be common to all Core Groups,
2. “Engineering Materials” can be prerequisites to impact of corrosion on metals as many civil engineering materials is the important area of concern.
3. “advanced polymers and ceramics” are the matter of general approach to all but especially to electronics group as an emerging development in this sector
4. Chemical science has contributed in many ways to most of the Engineering branches where “Applied Chemistry” such as water, polymers, corrosion, electro chemistry, alloys and ceramics, can be prerequisites to many subjects of all core groups from the perspective of applications as a build material for structural as well as maintenance component in electronics.

Course Objectives:

1. To study effect of hardness of water on various materials used in electronics.
2. To introduce important properties of polymers as Engineering material.
3. To study the effect of corrosion by different mechanisms on metals and methods of corrosion control
4. To study electrochemistry for give a general idea on various basic theories used in electronics.
5. To recognize importance of alloys and can apply the phase rule on it to study the effect of temperature and composition
6. To study the ceramics as an important part as a structural component used in electronics.

Course Outcomes: Student will be able to –

1. determine the hardness of water and various method of water hardness removal.



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2. use the polymers for specific engineering applications on the basis of the properties.
3. understand the causes of corrosion and apply different methods to minimize corrosion.
4. determine the electrochemical reactions and their impact.
5. understand the various alloys and to Interpret various phase transformations of alloy using thermodynamics.
6. Understand the role, purpose and use of ceramics as a structural component used in electronics.

Prerequisite: (For Theory Course)

1. Knowledge about basic concept of hardness of water.
2. Knowledge of basic properties of polymers.
3. Knowledge of basic concept of electrochemistry and corrosion mechanism.
4. Knowledge of concepts of nanomaterial.
5. Knowledge of basic difference of ferrous and nonferrous alloys.
6. Knowledge of constituents of materials used in electronics equipment.

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

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Knowledge about basic concept of hardness of water, properties of polymers, concepts of Electrochemistry and corrosion mechanism, nanomaterials and its application, properties of metals and nonmetals and purpose of making alloys,		



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		Constituents of materials used in electronics equipment.		
I	Water	1. Impurities in water, Hardness of water 2. Determination of hardness of water by EDTA method and numerical problems, 3. softening method of water and numerical based on it –i) Ion exchange process ii) electro dialysis iii) reverse osmosis iv) ultrafiltration. 4. Definition, significance and numerical problems based on BOD and COD.	05	CO1
		Self-learning Topics: 1. Industrial water treatment in semiconductor manufacturing. 2. Environmental impact of electronic industry wastewater. 3. Water purification technologies in PCB fabrication. 4. BOD & COD monitoring in electronics waste management. 5. Innovations in reverse osmosis and nano-filtration systems.	05	



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II	Advanced polymers.	- Macro-molecular science, i) basic concept of polymers, ii) Chemical bonding in polymers, iii) Classification of Polymers. - Properties of Polymers: - i) Molecular weight - Number average molecular weight, Weight average molecular weight, Numerical, ii) Crystallinity - Crystalline and amorphous polymers – Glass transition temperature. - Advanced polymers: i) Conducting polymers: ICP, DCP, ECP, Coordination conducting polymers, ii) Application of conducting polymers.	05	CO2
		Self-learning Topics: - Conducting polymers in flexible electronics - Application of intrinsically conductive polymers (ICPs) in sensors and OLEDs. - Biodegradable polymers in electronic packaging - Glass transition temperature and its role in 3D printing of electronic devices	05	



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		5. Polymer nanocomposites in EMI shielding.		
III	Corrosion	1. Introduction: Definition, Types of Corrosion – i) Dry or Atmospheric Corrosion, ii) Wet or Electrochemical corrosion (In Acidic medium, In Neutral medium) 2. Factors affecting rate of corrosion: i) Position of metal in galvanic series, ii) Purity of Metal, iii) Nature of Corrosion product, iv) Temperature, v) pH of medium, vi) concentration of medium, vii) moisture, viii) Relative Cathodic and Anodic area, ix) overvoltage 3. Methods to control corrosion: i) Selection of metal, ii) Proper Designing, iii) Cathodic protection, iv) Use of Corrosion Inhibitors, v) Metallic Coating- metal cladding, galvanization, tinning, metal spraying	05	CO3
		Self-learning Topics: 1. Corrosion issues in microelectronics and circuit boards 2. Corrosion protection in wearable electronics.	05	



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		- Nano coatings and corrosion-resistant materials in sensors. - Electrochemical corrosion testing techniques. - Corrosion in lithium-ion batteries.		
IV	Important Engineering materials: Nano materials:	- Nano materials: fullerene – properties and uses - carbon nano tubes- properties, method of preparation. - applications of CNTs	04	CO4
		Self-learning Topics: - Applications of carbon nanotubes in VLSI and NEMS/MEMS. - Fullerene-based drug delivery and biosensors. - Synthesis methods for nanomaterials (sol-gel, hydrothermal). - Toxicological impact of nanomaterials in electronics. - Graphene in transparent electronics and photonics.	04	
V	Alloys	Alloys: Ferrous alloys – i) Plain-carbon steels ii) Heat and Shock resisting steels iii) Stainless steels iv) Effect	06	CO5



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		of the alloying element- Ni, Cr, Co, Mn, Mo, W and V. 2. Non Ferrous alloys: A) Aluminum alloys – Composition, properties and uses of i) Duralumin, ii) Magnalium B) Copper alloys – Composition, properties and uses of a) Brass – i) Dutch Metal ii) German Silver b) Bronze – i) Gun metal ii) Nickel bronze. C) Alloys of Pb – Composition, properties and Uses of i) Wood's metal ii) Tinman's solder. 3. Numerical: i) based on Composition, ii) based on density iii) based on weight of an alloy. 4. Smart alloys: Types, composition and application of smart alloys in electronics		
		Self-learning Topics: 1. Smart alloys in actuators and MEMS devices. 2. Ferrous vs. non-ferrous alloys in electronics heat sinks. 3. Solder alloys in surface mount technology (SMT). 4. Effect of alloying elements on electrical conductivity.	06	



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		5. Shape memory alloys in micro positioning systems.		
VI	Important Electronics Engineering materials	1. Introduction, 2. Materials required in electronics component: i) Silicon and related materials, ii) Germanium and related materials, iii) Gallium compounds, iv) Carbon based materials, v) Conductive and insulating materials, vi) Magnetic materials 3. Etching materials: i) Hydrofluoric acid ii) Phosphoric acid, iii) Chlorine and fluorine based gases.	05	CO6
		Self-learning Topics: 1. Silicon purification process in IC fabrication. 2. Gallium arsenide and its use in RF and microwave devices. 3. Germanium-based materials for IR detection. 4. Magnetic materials in transformers and storage devices. 5. Etching gases and safety protocols in cleanrooms.	05	

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3. Polymer science: Vasant Gowarikar, Wiley Eastern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science: F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry, Oxford University Press, 5 th edition

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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	
13121203	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	Total .					
13121203	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. Engineering Mechanics plays a vital role for students of Electronics - Telecommunication and Computer Science - Engineering by bridging the gap between software, electronics, and the physical world. It supports the understanding of mechanical behaviour in electromechanical systems such as sensors, actuators, antennas, and robotic communication systems. With the growing integration of IoT, embedded systems, and cyber-physical technologies, a solid grasp of mechanics is essential for designing reliable, efficient, and physically robust systems. The subject contributes to vibration analysis, structural hardware design, and the simulation of physical behaviours, enabling students to develop smart, adaptive systems in advanced applications like automation, control systems, AR/VR, and digital twins.

Course Objectives

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

Course Outcome

- 1 Demonstrate the understanding of Centroid and MI 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.



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Detailed Syllabus

Module no.	Module Name	Detailed content	Teaching hours	CO
0	Prerequisite	Statics, Dynamics, Kinetics, Kinematics, Rigid body, Deformable body, applying trigonometric functions, resolution of a vector (Force vector), Law of triangle, Polygon law of forces, Newton's laws of motion Velocity, acceleration, displacement, Uniform velocity and accelerated motion, Law of conservation of Energy, Law of conservation of Momentum, work-energy principle, impulse and momentum principle, and Co-efficient of restitution	01	
1	Centroid	i. Characteristics, and real-life significance for Centroid ii. Centroids of primary geometrical shapes and plane laminas	03	CO1
		Self-learning topic: - Centroid for area with sector and real-life application - Exploring Moment of Inertia for primary geometrical shapes and plane laminas	03	
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 system of forces	05	CO2



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		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	
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	07	CO3
		Self-learning topic: - Equilibrium of connected bodies (beam and sphere), two force and three force members, beams connected using internal hinges - Application of equilibrium with friction - Wedge and block	07	
4	Kinematics of particles and rigid bodies	i. Motion along plane curved path, Variable acceleration for rectilinear motion, projectile motion ii. Introduction to General plane motion, problem based on Instantaneous centre (ICR) method for general plane motion (up to 2 linkage mechanism and roller)	06	CO4



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		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	
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)	04	CO5
		Self-learning topic: - Application of WEP to the real-life problems - Explore the concept of impact and collision for rigid bodies	04	
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)	04	CO6
		Self-learning topic: - Derive and Analyze - Manual derivation of forward kinematics using D-H parameters - Explore online simulation tools such as MATLAB Robotics Toolbox Online and refer https://kinematicsplayground.org/ - Solve 2 numerical problems involving: Assigning D-H parameters and finding of	04	



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		end-effector pose using transformation matrices		
Total			60	

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/45
		L	T	P	L	T	P	SL	Notional Learning Hour	
13211204	Digital Electronics	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211204	Digital Electronics	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To enable students to **understand and simplify** logic functions using Boolean algebra, De Morgan's Theorems, and Karnaugh maps.
2. To enable students to **design and analyze** combinational circuits like adders, multiplexers, encoders, decoders, and comparators.
3. To enable students to **explain and analyze** sequential circuits including latches, flip-flops, counters, and shift registers.
4. To enable students to **compare and classify** different memory types such as ROM, RAM, EPROM, EEPROM, static and dynamic RAM.



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5. To enable students **to design FSMs** (Moore and Mealy models) and study asynchronous circuits and hazards.
6. To enable students to **understand and apply** data converters (ADC/DAC) and PLDs like PAL, PLA, CPLD and FPGA

Course Outcomes:

1. **Formulate and simplify** logic expressions using Boolean algebra, De Morgan's theorems, and Karnaugh maps.
2. **Design and implement** combinational logic circuits such as adders, subtractors, multiplexers, encoders, decoders, and comparators.
3. **Analyze the operation** of sequential circuits including latches, flip-flops, counters, shift registers, and finite state machines (FSMs).
4. **Differentiate** various types of memory (ROM, RAM, EPROM, EEPROM) and explain timing parameters like setup time, hold time, and propagation delay.
5. **Explain and evaluate** the operation of programmable logic devices (PLDs) such as PAL, PLA, CPLD, and FPGA for digital logic implementation.
6. **Interpret and compare** the working of different types of ADCs and DACs, including their circuit structures and applications.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Binary number system and codes, binary arithmetic		
1	Implementation of Logic Functions	Formulating a logic function, Sum of Products (SOP), Product of Sums (POS), Minimization using Boolean Algebra, De Morgan's	07	CO1



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		Theorems, Minimization using Karnaugh map (up to 4 variables).		
		Self-Learning: - Practice drawing truth tables and converting to SOP/POS - Use Boolean laws to simplify given expressions. - Practice K-map grouping with different minterm combinations - Solve MCQs or logic circuit design problems from textbooks or online platforms.	07	
2	Combinational Circuit Design	Introduction to combinational circuits, Adder, Subtractor, Multiplexer (16:1, 8:1, 4:1), Demultiplexer, Decoder (3:8 and 5:12) and Encoder (Priority Encoder), Code converters, Comparator(2-bit), ALU. Static and dynamic hazards in combinational circuits	08	CO2
		Self-Learning: - Design a N:1 multiplexer / 1:N De-Multiplexer and write the truth table. Implement a Half/full adder using two half adders and logic gates. Implement same with Multiplexer. - Construct a priority encoder for 4 inputs. Identify and remove static hazard from the expression: $Y = A'B + ABY =$	08	



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		$A'B + BY = A'B + AB.$ Take some 3-4 digit binary numbers and convert them into Gray code.		
3	Flip-Flops And Memories	Storage elements: Latches and Flip-flops (S-R, J-K, D, T Flip-flop), Master Slave Flip-flop. Triggering, Propagation delay time, setup time, hold time. Memories – ROM, RAM, EPROM, EEPROM – Volatile and non-volatile – Static and dynamic RAM	08	CO3
		Self-Learning: Understand and compare different flip-flops (S-R, J-K, D, T, Master-Slave) with their symbols, truth tables, and timing diagrams. Learn key timing parameters: triggering types, propagation delay, setup time, and hold time through diagrams and examples. Study memory types: ROM, RAM, EPROM, EEPROM, and classify them as volatile or non-volatile, static or dynamic. Compare SRAM and DRAM in terms of working, speed, cost, and usage in real systems (e.g., cache vs main memory).	08	



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4	Sequential Circuit	Synchronous and Asynchronous counters, Shift registers and their applications, Analysis of Moore and Mealy Type Finite State Machines (FSM), State Reduction Introduction to Asynchronous Sequential circuits, Essential hazards in asynchronous sequential circuits	08	CO4
		Self-Learning: • Synchronous vs Asynchronous Counters – Working and differences. • Shift Registers – Types and simple applications. • Moore vs Mealy FSMs – State diagrams and differences. • State Reduction – Basics of minimizing FSM states. • Asynchronous Circuits & Hazards – Introduction and essential hazard types.	08	
5	Programmable Devices	Structure of Programmable Logic Devices (PLDs), Function implementation with PAL and PLAs, Numerical on PLA and PLD. Introduction to CPLD and FPGA	07	CO5
		Self-Learning: • Structure of PLDs – Basic architecture and types • PAL and PLA – Difference, structure, and function implementation. • Numerical on PAL/PLA – Logic realization examples.	07	



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		Introduction to CPLD and FPGA – Features and applications		
6	Introduction to Logic Family Analog And Digital Interface	Characteristic parameters of logic families: Voltage and Current parameters, Fan in, Fan out, Noise margin, Power Dissipation, Propagation Delay TTL NAND gate and its transfer characteristics, CMOS inverter and transfer characteristics, comparison of TTL and CMOS logic families Analog to digital converters – Successive approximation method – Counter type converter. Digital to analogue converters – Binary weighted D/A converter – R/2R ladder network converter Self-Learning: Types of A/D Converters – Parallel Comparator, Dual Slope, Successive Approximation, Counter Type Types of D/A Converters – Binary Weighted, R/2R Ladder Network Basic Concept of Bus Standards – Purpose, examples (e.g., data, address, control buses) Case Study 1: Comparative Analysis of TTL and CMOS Logic Families in Low-Power Digital Applications Case Study 2: Design and Implementation of Digital	07	CO6
			07	



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		Systems Using Combinational and Sequential Logic Circuits Case Study 3: State Machine Optimization: Moore vs. Mealy FSMs in Real-Time Applications Case Study 4: Simulation and Performance Evaluation of ADC and DAC Circuits Using SPICE/HDL Tools		
	Total		90	

Text Books:

1. John F. Wakerly, "Digital Design Principles and Practice"- Pearson Publications, 4th edition.
2. Morris Mano, Michael D. Ciletti, " Digital Design with introduction to Verilog HDL" Pearson, 5th edition
3. John M. Yarbrough, "Digital Logic Applications and Design" – Thomson Publications .
4. Stephen Brown and Zvonko Vranesic, "Fundamentals of digital logic design with Verilog design", McGraw Hill, 3rd Edition.
5. Roth and Kinney, "Fundamentals of Logic Design", Cengage learning, 7th edition

Reference Books:

1. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing [8] Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"
2. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India

Online References:

Sr. No.	Website Name



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1.	https://onlinecourses.nptel.ac.in/noc20_ee32/preview
2.	https://archive.nptel.ac.in/content/storage2/courses/106108099//Digital%20Systems.p df



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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	
13112205	Engineering Chemistry for Electronics 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	Total .					
13112205	Engineering Chemistry for Electronics Lab	-	-	-	-	-	25	--	25

Lab Objectives:

1. To apply knowledge acquired during the theory class in carrying out the experiments for qualitative and quantitative determination.

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2. To analyze experimental results and write laboratory report.

Lab Outcomes: After completion of experiment, the learners will be able to

1. Estimate the type of water hardness and calculate it.
2. Synthesize UF/PF resin at laboratory level.
3. Learn the effect of various factors on the rate of corrosion.
4. Understand the significance of electrochemistry principles
5. Learn various volumetric quantitative analytical techniques to determine % of elements from alloy samples and concept of smart alloys used in electronics
6. Learn various instrumental quantitative analytical techniques to determine % of elements from alloy samples and concept of smart alloys used in electronics.

List of Experiments:

Sr No	List of Experiments	Hrs
01	Determination of Total, Temporary and Permanent hardness of water by EDTA method	01
02	Estimation of chloride content in the given water sample.	01
03	Synthesis of Urea formaldehyde Resin.	01
04	Synthesis of Phenol formaldehyde resin.	01
05	To compare the rate of corrosion of various metals in acidic medium.	01
06	Determination of % purity of iron.	01
07	Determination of Sn from soldiers volumetrically.	01
08	Determination of unknown concentration of Cu in the given sample by colorimetry	01



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09	Determination of unknown concentration of Fe in the given sample by colorimetry	01
10	Determine the unknown PH of sample by PH meter	01

List of assignments:

Sr No	List of Assignments	Hrs
01	Numerical on determination of hardness of water and on determination of BOD and COD	01
02	Short note on advanced polymers used in electronics.	01
03	Short note on various corrosion control techniques	01
04	Short note on CNT.	01
05	Short note on smart alloys: some examples of smart polymers with their properties and uses.	01

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06	Short note on Etching materials.	01

References:

1. Engineering Chemistry, Jain and Jain, Dhanpat Rai Publication
2. A textbook of Engineering Chemistry, S. S. Dara, S. Chand and Company
3. Polymer science: Vasant Gowarikar, Wiley Eastern Ltd, new Delhi
4. Green Chemistry: V. K. Ahluwalia
5. Textbook of Polymer science: F.W. Billmeyer
6. Fundamentals of Polymer science & Engineering- Anilkumar & S K Gupta, Tata McGraw Hill, New Delhi
7. Engineering Chemistry, O. G. Palana, Tata McGraw Hill Publication
8. Environmental Chemistry, A. K. De, Tenth edition, New Age International,
9. P. W. Atkins, Physical Chemistry, Oxford University Press, 7th edition. 5. J. D. Lee Concise Inorganic Chemistry, Oxford University Press, 5 th edition.

Online Resources:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/103/106/105106205/
2.	https://courses.nptel.ac.in/noc20ch41/preview
3.	https://www.researchgate.net/
4.	https://www.sciencedirect.com/topics/engineering/polymer-material
5.	https://www.sciencedirect.com/topics/chemistry/nanomaterial

Assessment:



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Term Work: Term Work shall consist of at least 10 practical based on the above list.
Also, Term work Journal must include at least 6 assignments.

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



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		L	T	P	L	T	P	SL	Notional Learning Hour	
13122206	Engineering Mechanics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration(in Hrs)			
		IAT 1	IAT 2	Total.					
13122206	Engineering Mechanics Lab	--	--	--	--	--	25	25	50

Lab Objectives:

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

Lab Outcomes:

- 1 Demonstrate the understanding of Centroid locate the same.
- 2 Determine the resultant and equivalent force-couple system for a given system of forces.

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- 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)	02	CO2
2	Verification of the Principle of Moments (Bell crank lever)	02	CO2
3	Determination of Centroid of plane lamina made up of standard geometrical shapes	02	CO1
4	Determination of support reactions of a Simply Supported Beam.	02	CO3
5	Determination of coefficient of friction using inclined plane	02	CO3
6	Verification of the equations of equilibrium for non-concurrent non-parallel (General) force system.	02	CO3
7	Kinematics of particles. (Uniform motion of a particle, Projectile motion, motion under gravity)	02	CO4
8	Collision of elastic bodies (Law of conservation of momentum).	02	CO5
9	Kinetics of particles. (collision of bodies)	02	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 06 practicals based on the above list. Also, Term work Journal must include all the assignments listed above.

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

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



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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	
13122207	Programming Lab (Python)	2	--	2	30	--	30	--	60	2

Course Code	Course Name	Examination Scheme							
		Theory Marks				Term work	Practical / Oral	Tut.	Total
		Internal assessment			End Sem. Exam				
		IAT-1	IAT-2	Total					
13122207	Programming Lab (Python)	--	--	--	--	25	25	--	50

Lab Objectives: To familiarize learners with Python's basic syntax, variables, data types, operators, and input/output functions.

1. To reinforce the understanding and application of conditional statements, loops, and functions in Python programming.
2. To instill learners on file handling, exception management, and Python packaging.
3. To introduce object-oriented programming principles and their application in Python.
4. To explore advanced topics such as regular expressions, pattern matching, and GUI development.
5. To introduce and demonstrate the use of popular Python libraries for data handling.

*R-2025- F.E. Electronics and Computer Science***Lab Outcomes:** After completion of experiment, the learners will be able to

1. Demonstrate the proficiency in basic python programming or create and perform various operations on data structures like list, tuple dictionaries and strings.
2. Apply Control Flow and Functions for efficient coding to solve problems.
3. Demonstrate proficiency in handling file operations, managing exceptions, and developing Python packages and executable files for modular programming.
4. Illustrate the concept of Object-Oriented Programming used in python.
5. Design Graphical User Interface (GUI) applications, utilizing appropriate Python libraries to create user-friendly interfaces.
6. Investigate and apply popular python libraries to conduct efficient data handling tasks.

Prerequisite:

1. Logical Thinking & Problem Solving: Ability to break down problems into smaller parts. Basic understanding of flowcharts or algorithmic thinking.
2. Mathematical Reasoning: Basic arithmetic operations (addition, subtraction, multiplication, division).
3. Understanding of variables, functions, and formulas (from school-level math).
4. Analytical Skills: Ability to spot patterns, debugs issues, and evaluates outputs.

DETAILED SYLLABUS:

Sr. No.	Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Comment (Prerequisite syllabus should not be considered for paper setting)	01	
1	Introduction to Python	1.1 Evolution of Python & its role in modern tech stacks, Python in web development, data science, automation, AI. 1.2 Basic Syntax and Data Types - Variables and data types, Operators, Input and output,	05	CO1



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		1.3 Real-world data modeling with Python data types (int, float, str, list, tuple, dict, set) 1.4 Operators with hands-on examples from finance, gaming, etc., Industry Task: Build a basic expense tracker using lists and dictionaries		
2	Control Flow and Functions	2.1 Conditional Statements: if-elif-else in decision- based apps 2.2 Loops (for, while) in automation & report generation, 2.3 Loop control: break, continue, pass 2.4 Functions- Defining functions, Parameters and return values, Scope and lifetime of variables	05	CO2
3	File Handling, Packaging, and Debugging	3.1 File Handling- Reading and writing files, 3.2 Exception handling 3.3 Creating Python Packages, Modules and executable files 3.4 Dealing with Syntax Errors, Runtime Errors and Scientific Debugging	05	CO3
4	Object-Oriented Programming (OOP) in Python	4.1 Introduction to OOP: Classes and objects, 4.2 Encapsulation, inheritance, and polymorphism 4.3 Creating Classes and Objects: Class attributes and methods Constructor and destructor. 4.4 Type of Inheritance: Single, multiple and multilevel inheritance	05	CO4

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5	Advanced Python Concepts	5.1 Regular Expressions, Pattern matching, Regex functions in Python 5.2 GUI Development using any Python GUI framework	05	CO5
6	Python Libraries	6.1 Introduction to Popular Libraries 6.2 NumPy for numerical computing, 6.3 Pandas for data manipulation. 6.4 Matplotlib for data visualization functional ceramics, ceramic coatings.	05	CO6

Text Books:

1. Core Python Programming, Dr. R. Nageswara Rao, Second Edition, Dreamtech Press.
2. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox Publication.
3. Python Programming, Anurag Gupta and G. P. Biswas, First Edition, McGraw-Hill

Reference Books:

1. Learn Python the Hard Way, Zed Shaw, Third Edition, Addison-Wesley.
2. Python Projects, Laura Cassell, Alan Gauld, First Edition, Wrox Publication.
3. Introduction to computing and problem-solving using python, Balagurusamy, First Edition, McGraw Hill Education.

Online Resources:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106145
2.	https://onlinecourses.swayam2.ac.in/cec22_cs20/preview
3.	https://www.researchgate.net/

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4.	https://www.sciencedirect.com/science/article/pii/S2666920X24001127
5.	https://www.sciencedirect.com/search?qs=python%20programming

Suggested List of Experiments: (Expected Minimum 15 Experiments to be performed)

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 python programs, which will serve as the foundational tool for all further experiments in the lab.	02
02	Personalized Greeting Generator - Write a python code to generate Personalized Greeting.	02
03	Calculating Areas of Geometric Figures - Write a python program to calculate areas of any geometric figures like circle, rectangle and triangle.	02
04	Calculating Gross Salary of an Employee: Write a Python program to calculate the gross salary of an employee. The program should prompt the user for the basic salary (BS) and then compute the dearness allowance (DA) as 70% of BS, the travel allowance (TA) as 30% of BS, and the house rent allowance (HRA) as 10% of BS. Finally, it should calculate the gross salary as the sum of BS, DA, TA, and HRA and display the result.	02
05	Task List Manager: Develop a Python program to manage a task list using lists and tuples, including adding, removing, updating, and sorting tasks.	02
06	Student Record Keeper: Write a Python program to create, update, and manipulate a dictionary of student records, including their grades and attendance.	02
07	Triangle Pattern Generator Using Loops: Write a Python program to print a triangle pattern (give any), emphasizing the transition from C to Python syntax.	02

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08	Number Type Identifier: Develop a Python program that takes a numerical input and identifies whether it is even or odd, utilizing conditional statements and loops.	02
09	Grade Evaluator: Develop a Python program that takes marks and evaluates grade using if-elif-else	02
10	Fibonacci Sequence Generator: Write a Python program to generate the first N terms of the Fibonacci series using loops.	02
11	Multiplication Table Generator: Write a Python program to take a numerical input from the user and generate its multiplication table using loops.	02
12	Extracting Words from Text File: Develop a Python program that reads a text file and prints words of specified lengths (e.g., three, four, five, etc.) found within the file.	02
13	Basic Exception Handling: Write a Python program that takes two numbers as input and performs division. Implement exception handling to manage division by zero and invalid input errors gracefully.	02
14	Online ATM System: Develop classes for ATM. Include methods for withdraw, deposit and check balance.	02
15	Password Strength Checker: Write a Python script that prompts the user to enter a password. Use regular expressions to validate the password based on these criteria: At least 8 characters long, Contains at least one uppercase letter, one lowercase letter, one digit, and one special character.	02

Assessment:

Term Work: Term Work shall consist of at least 15 practical based on the above list. Also, Term work Journal must include 1 mini project based on above syllabus.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (mini 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 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	
13122208	IDEA LAB - II (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	Total.				
13122208	IDEA LAB - II (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

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problems with multiple solution pathways.

5. To enhance communication, collaboration, and documentation skills essential for professional engineering practice.
6. To build an entrepreneurial and research mindset by guiding students to develop scalable, socially-relevant, and technically viable prototype

Lab Outcomes: Student will be able to

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

1) Guidelines for IDEA Project

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

- Each student works on an individual interdisciplinary project aligned with the semester theme.
- Faculty in-charges for the IDEA Lab are assigned according to the complexity of the project and the capacity of the respective departments.
- Faculty in-charges mentor both the academic and technical aspects, and track weekly progress.
- Project assessment will be rubric-based, ensuring depth, innovation,



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



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

2) Implementation Strategy

a) Project Implementation in IDEA Lab

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



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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:
 - Logbooks



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- o Subject-specific outputs (e.g., simulations, designs)
- o Paper publications or review presentations

1) Guidelines for Assessment

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

a) Assessment of IDEA Lab Projects (Individual Interdisciplinary Projects) (25 Marks)

Presentation-Based Assessment Structure (Total: 25 Marks)

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

Rubric-Based Evaluation Criteria

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



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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

Component	Marks	Assessed By
Termwork – Project Execution	25 Marks	Project Guide



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Component	Marks	Assessed By
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 Learnin g Hour	
13212209	Digital Electronics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total.				
13212209	Digital Electronics Lab	--	--	--	--	25	25	50

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Pre-requisite: Binary number system and codes, binary arithmetic

Lab Objectives:

Lab course aims to

1. To enable students to minimize real-world Boolean functions with multiple inputs using standard simplification techniques.
2. To enable students to design, implement, and verify basic combinational circuits such as adders, subtractors, multiplexers, demultiplexers, encoders, decoders, comparators, and code converters.
3. To enable students to analyze the operation and timing of flip-flops and memory elements, fostering technical and analytical skills.
4. To enable students to design and analyze counters, shift registers, and finite state machines.
5. To enable students to study the structure of PLDs and implement logic functions using PAL, PLA, CPLD, and FPGA.
6. To enable students to study the characteristics of logic families and analyze the performance of A/D and D/A converters using various circuit techniques.

Lab Outcomes:

1. Apply Boolean algebra and graphical techniques for logic simplification.
2. Design and implement basic combinational logic circuits.
3. Analyze and implement sequential circuits including FSMs.
4. Simulate and evaluate the performance of logic circuits and data converters.
5. Understand and compare the characteristics of digital logic families.
6. Implement logic functions using programmable logic devices and reconfigurable hardware.



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DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	Binary number system and codes, binary arithmetic		
1	To minimize Boolean expressions using Boolean algebra rules.	2	LO1
2	To implement logic functions using Sum of Products (SOP)/Product of Sum (POS) form.	2	LO1
3	Implementation and Verification of Half Adder and Full Adder	2	LO2
4	Design and Implementation of 4:1, 8:1, and 16:1 Multiplexers	2	LO2
5	Implementation of 2-bit Binary Comparator	2	LO2
6	Design and Verification of a Parity Generator	2	LO2
7	Design and implementation of synchronous counters	2	LO3
8	To perform state reduction and simplification of Finite State Machines (FSMs) for efficient sequential circuit design.	2	LO3
9	Implementation of logic functions using Programmable Array Logic (PAL)	2	LO6
10	Implementation and simplification of Boolean functions using Programmable Logic Array (PLA)	2	LO6
11	Analysis of Characteristic Parameters of TTL and CMOS Logic Families	2	LO5
12	Transfer Characteristics of TTL NAND Gate and CMOS Inverter	2	LO5

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13	Simulation of Successive Approximation Analog to Digital Converter (ADC)	2	LO4
14	Simulation of R-2R Ladder Digital to Analog Converter (DAC)	2	LO4
15	Presentation / Case Study Topic "Design and Analysis of Digital Circuits: From Logic Families to Data Conversion Techniques" Comparative study of TTL and CMOS logic families Implementation and behavior of combinational and sequential circuits • State machine design and state reduction techniques. • Role of PLDs, CPLDs, and FPGAs in digital design. • A/D and D/A conversion methods (Successive Approximation, Counter-type, R-2R Ladder, etc.). • Real-world relevance through analysis of performance parameters, hazards, and applications	2	LO1-LO6 (Integrated)

Recommended Books:

1. Morris Mano, Michael D. Ciletti, "Digital Design with introduction to Verilog HDL" Pearson, 5th edition
2. Sameer Palnitkar, "Verilog HDL: A guide to digital design and synthesis"
3. William I. Fletcher, "An Engineering Approach to Digital Design", Prentice Hall of India



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Online Resources:

Sr. No.	Website Name
1.	CircuitVerse - Online Digital Logic Circuit Simulator
2.	Online circuit simulator & schematic editor – Circuit Lab

Assessment:

Term Work: Term Work shall consist of at least 8 to 10 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: A practical/ Oral 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	
13412210	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-I	IAT-II	Total				
13412210	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 of 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

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- applications of drones in the real-world.
5. To familiarize students with the components and operation of 3D printers.
 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	

Reference Book

1. IoT: Building Arduino-Based Projects by Peter Waher.
2. Robotics: Modelling, Planning and Control by Bruno Siciliano, Lorenzo Sciacivco, Luigi Villani, Giuseppe Oriolo.
3. 3D Printing: A Practical Guide for Librarians by Sara Russell Gonzalez, Denise Beaubien Bennett.



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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 the working of mini drone.	8

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	
98461211	Universal Human Values	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
98461211	Universal Human Values	-	-	-	-	-	25	-	25

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

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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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DETAILED SYLLABUS:

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

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		Self-Learning Topics: Practices adopted in ancient India for preserving the environment, Importance of rivers, trees, water mentioned in Indian scriptures and culture. Modern technologies/practices favoring ecosystem preservation. (Past Practices Vs, Present Practice)	6	
VI	Integrating universal human values in the workplace	Meaningful and Purposeful Work: Encouraging dignity in all types of jobs. Human creativity and contribution to society. Equal opportunities without discrimination. Prioritizing human well-being over mere profit. Technical education is enriched with ethics and human-centric values. Ethical behavior includes not exploiting others for personal gain—whether as employers or consumers. Ability to identify and develop appropriate technologies and management patterns for production systems. Case studies of typical holistic technologies, management models and production systems. Self-Learning Topics: Contemporary workplace scenario Confronting challenges like globalization, technological advancement/disruption cultural diversity, workplace prejudice. unconscious bias. Hampering output and how universal human values helps erasing these complexities.	5 5	CO6

References:

1. Gaur, R. R., Sangal, R., & Bagaria, G. P. (2009). *A Foundation Course in Human Values and Professional Ethics*. New Delhi: Excel Books.
2. Ravindran, P. S. (2007). *Essence of Human Values and Professional Ethics*. Chennai: Sri Ramakrishna Math.
3. Gaur, R. R. (2011). *Human Values and Professional Ethics*. New Delhi: Dhanpat Rai Publishing Company.
4. Chitkara, M. G. (2002). *Education and Human Values*. New Delhi: A.P.H. Publishing Corporation.
5. Martin, M. W., & Schinzinger, R. (2005). *Ethics in Engineering* (4th ed.). New York: McGraw-Hill.

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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)

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 be understanding help in addressing environmental issues?

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

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

Rationale:

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The course equips electronics and telecom engineers with effective technical and persuasive oral and written proficiencies essential for the environment to create high tech systems and services, Students will learn to decode complex technical ideas and messages, grasp foundational communication models, and develop hands-on expertise in verbal, nonverbal, and digital communication channels. These abilities are vital for professionals to interface with government bodies, private investors, infrastructure partners, and the general public. It helps enhance both a firm's brand identity and its reputation as these interactions are critical for the planning, implementation of various project ideas The curriculum strengthens all four LSRW competencies—Listening, Speaking, Reading, and Writing—to ensure engineers with the proficiency required to convey technical and non-technical information with accuracy, assurance, and professionalism in diverse professional contexts.

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

1. Effectively explore the dynamics of communication and navigate professional arenas

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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 and adapt the dynamics of communication to navigate modern professional arenas.
2. Acquire active listening skills by practicing technical and business Speech Acts using direct and digital mode.
3. Analyze barriers, methods, audience and purposes for mastering individual and team speaking in professional & business settings.
4. Synthesize extensive technical and business texts for reflective learning through reading and summarization.
5. Design purposeful and ethical technical and business content, presentation using ICT enabled media.
5. Advocate technical excellence to propagate ethical & sustainable community solutions with a career oriented approach.

Prerequisite: Basic knowledge of English language



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic knowledge of English language.		
I	Communication Dynamics	Foundations of Communication Dynamics: Objectives Linear vs. Transactional Models Encoding, Decoding, and Feedback, Interpersonal Communication in Groups: Verba interaction : Meetings & Presentations, Teleconferences & Calls and Non-Verba Interactions: Proxemics, Haptics Oculistics Kinesics Digital Interaction: virtual teams, vide calls. Formal and Informal Communicatio Channels . Barriers: Physical Semanti Psychological & Emotional Barriers, Cultural & Contextual Barriers Silos mentality, Hierarchica layers, Rigid policies, unclear channels, an outdated technology. Self Learning Topics: Communication a Workplace & Outer Agencies Interna communications: Regular email updates, Vide conferencing and face to face sessions. Externa Communication Enterprise Social Media & Networking. Printed and environment Media	5 5	CO1



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		Industry collaboration readiness.		
II	Active Listening	Active Listening: Discussions, and note-taking techniques. Audio-book listening, Understanding colleagues' and clients during meetings. Types of Listening Comprehensive Listening , Critical Listening and Reflective /Empathetic Self Learning Topics: Listening kryptonite : Distractions and Preoccupations Semantic Jargons information overload, speaker pace, Pseudo listening & Interruptions Neglecting Nonverbal Cues, Knowledge Hiding & Siloed Departments	2 2	CO2
III	Conversational Proficiencies	Technical Communication Skills Technical Discussion, delivering technical oral presentations inside and outside organizations Q&A, Explaining Engineering Concepts in Simple Terms (Tips & Guidelines) Grooming and Self Development: Self Learning Topics: Customer pitches and stakeholder meetings. Vendor evaluations or regulatory compliance., vendors as strategic partners, Vendor Negotiations or Demos, Risk & Contingency Planning, Consensus for brainstorm.	2 2	CO3
IV	Text Interpretation Expertise	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		CO4



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		Organizers (GO) Infographics , Process Flowcharts & Swimlane Diagrams SWOT analysis KWL Charts, Different Types of Organograms etc. Summarising text in point form. Leveraging Online Resources like IEC standards Market Research Report , Business Case study , Tech Business News, Product Management & Development, Financial & Strategy Reading. Self Learning Topics :Technical Vocabulary, Financial Reports of Electronics Companies' Annual Reports, Supply Chain & Manufacturing:	2 2	
V	Technical & Corporate Writing Skills	Seven Cs of Business Writing Completeness, Conciseness, Consideration, Concreteness, Clarity, Courtesy, Correctness. Format & Types of Formal Letters : Cover Letter, Inquiry Letter Offer Acceptance / Rejection Letter Quotation Letters Grievance Service Change Notification, Recommendation Letter. Technical Writing for Professionals: Short And Long Reports Formatting Guidelines Tips For Text Chat users manuals Standard Operating Procedures (SOP) Product Specification writing. Legal and compliance writing: Compliance Reports and License Agreement. Studio Activities	3	CO5



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		Self Learning Topics: Studio Activities: Content Creation for Social Media and e-Commerce Platforms Blogs, Vlog Keynote speeches Podcast titles Landing pages Social media posts, Short videos, YouTube video description	3	
VI	Community Communication and Ethics	Communicating clearly with non-technical users and stakeholders Building supportive networks Promoting innovation and problem-solving Participating in user groups or tech meetups Gain encouragement and advice on technical or career challenges. Sustainable smart urban infrastructure, Smart Waste Management Energy Efficiency & Management Communication Transparency and Honesty Accountability Avoiding Misuse of Information Uphold ethical standards in all written, verbal, and digital communication. Self Learning Topics : Ethical use of technology, Sustainable Study Habits: Time Management and Responsibility Active participation in professional communities, forums, and collaborative platforms.	1 1	CO6

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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

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/

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4.	https://venngage.com/blog/white-paper-examples/

Assessment

IAT -I 20 marks

IAT-20 Marks

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

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

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 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	
98422213	Enterprise Communication and Corporate Culture LAB	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Exam	Total
		Internal assessment			End Sem. Exam			
		IA T1	IAT2	Total				
98422213	Enterprise Communication and Corporate	--	--	--	--	25	-	25

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	Culture LAB							

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
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 communication principles for excellence in academic and professional settings.
2. Test listening capabilities for advanced listening strategies in physical and digital mode.
3. Evaluate and present ideas precisely to the audience in a confident way.
4. Demonstrate reading proficiencies through practicing extensive technical and non-technical texts.
5. Design digital technical and business write ups for professional transactions

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6. Implement interpersonal skills and professional ethics to provide fair and collaborative solutions.

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. Enterprise Communication: Industry Reports, and Articles News Letter, Brand messaging, Multi stakeholders collaborations. Private - Academic Partnerships	4	LO1
II	Active Listening	Comprehensive Listening and Applications: Technical or Business podcasts, You tube lecture on academic stuff/ processes/ procedures/ Development Plans.		



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		Critical Listening: Listen to an audio recording presentation, podcast Interviews and summarise in your words in an oral manner Reflective /Empathetic Listening: Paraphrase What You Hear, Reflect Emotions, Summarize Key Points, Review recorded calls.	4	LO2
III	Conversational Proficiencies	Conversational Activities -I Self Introduction, Prepared Speech on Technical Topics and Impromptu Speech on General Topics Conversational Activities-II Simulation in communication: Role Play Activity for Conflict Resolution Negotiation , Handling complaints or angry customers through simulated phone or chat interactions. Conversational Activities -III customer Communication, Cross-Cultural communication, Marketing & Brand Communication Handling Q&A in Presentation.	8	LO3
		Practice Verbal Ability Test (GRE TOEFL and IELTS for grammar and vocabulary Prepare Diagram Organizers on: Summarising text to Graphic Organisers (GO) Process Flowcharts & Swimlane SWOT		



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IV	Text Interpretation Expertise	analysis KWL Charts, Different Types of Organograms etc.as per the situations in the organizational setting. Summarising text in point form after reading Market Research Report , Business Case study ,Tech Business News	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 Quotation Letters Grievance Service Change Notification Letters Grievance Letter Letter Standard users manuals Operating Procedures (SOP) Data Privacy Policy , Compliance Reports and License Agreement Content Creation for Social Media CMS - Wordpress to create, manage and publish content. e-Commerce Platforms Blogs, Vlog Podcast titles,Landing pagesSocial media posts	6	LO5
VI	Community Communication and Ethics	Local Area Visit, Field Visits. BSNL , MTNL training Centre Surveys & gaining knowledge on switching mechanism telecom network Feedback Analysis and Report Writing ,Providing solutions for Technical issues.	4	LO6

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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/



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List of Experiments.

Sr. No	Name of Experiment	Hours
1.	Prepare a case study on Enterprise Communication strategies/Issues/Achievements in Select Indian Companies, Tata Consultancy Services (TCS), Infosys, Reliance Jio Infocomm Industries, Bharti Airtel Ltd., Vodafone Idea. BSNL, Tata Communication etc	02
2	Listening Skill Activity Sheet containing minimum three types of listening activities from Lab Syllabus. (Technical Podcasts, Video/Audios of meeting collaboration. Processes and descriptions on You tube channels.	02
3	A. Continuous Evaluation of at least three types of the activities from Lab Syllabus for proficiency in oral communication/presentation	02
4.	a. Two Verbal Ability Test based on GRE, TOEFL, IELTS b. Summary report and Graphic Organizers for the relevant scenario or situation c. Powerpoint / Slide Preparation on business 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



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6.	Conduct field visits to small scale business community / Government and non Government Agencies/ ,Metro Projects/ Local visit to MTNL and BSNL/ Traffic Management and ensure the implementation of your subject completely or partially for the smooth functioning of the system Conduct a Survey(Face to face, Kiosk /Mobile , QR Code/ SMS survey and get feedback from outside agencies regarding the future inputs for synergistic solutions.	02

Term Work - 25

Experiments/Practicals

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

20 marks

Attendance -5 Marks



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S. E. Syllabus



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SEM III

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R-2025- S.E (Sem-III) Electronics and Computer

ECS-Semester-3

Theme: "Digital Innovation for Urban Development and Environmental Sustainability"

- SDG 11: Sustainable Cities and Communities
- SDG 9: Industry, Innovation and Infrastructure
- SDG 13: Climate Action
- SDG 6: Clean Water and Sanitation
- SDG 3: Good Health and Well-being
- SDG 12: Responsible Consumption and Production

Keywords: Energy wastage, food waste, rainwater harvesting, traffic management, air pollution.

Description: The theme "**Digital Innovation for Urban Development and Environmental Sustainability**" focuses on leveraging emerging technologies and computational systems to address critical challenges in urban living. Across urban and institutional settings, a range of sustainability challenges persist—from energy wastage in educational campuses like Rahul Education, to unsafe road conditions in municipalities such as Mira-Bhayandar, to excessive food waste in college hostels and canteens. These issues are compounded by underutilized rainwater harvesting in residential buildings, worsening urban traffic congestion, and the silent threat of indoor air pollution due to inadequate monitoring. Despite isolated efforts, a common thread among these problems is the absence of data-driven, scalable solutions that are both cost-effective and easy to implement. Addressing these challenges through smart technology and community engagement can significantly advance multiple UN Sustainable Development Goals, including clean energy, good health, sustainable cities, responsible consumption, and clean water access.

Problem Statements:

1. Rahul Education faces ongoing energy wastage due to lights, fans, and devices being left on unnecessarily across campus buildings. Manual efforts to control usage have been ineffective, leading to higher costs and a larger carbon footprint. A simple, scalable solution is needed to monitor and reduce electricity waste, supporting the institution's sustainability goals. **(UNSD Goal: 7 – Affordable and Clean Energy)**



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2. The Mira-Bhayandar Municipal Corporation (MBMC) is facing a critical challenge in managing and maintaining its road infrastructure due to widespread potholes, open manholes, and incomplete road works. These conditions pose significant risks to public safety, causing frequent accidents and disruptions in daily commuting. Despite periodic repair efforts, the lack of a systematic monitoring, reporting, and prioritization mechanism has led to inefficient resolution and repeated infrastructure failures. **(UNSD Goal 9: Industry, Innovation and Infrastructure, Goal 3: Good Health and Well-being)**
3. College hostels and campus canteens frequently face the challenge of excessive food waste due to over-preparation, unpredictable attendance, and lack of planning. This not only leads to significant resource wastage but also contradicts efforts toward sustainable and responsible consumption practices. Despite existing manual efforts to estimate food demand, the absence of a data-driven approach to predict meal requirements and manage surplus food has resulted in repeated wastage. This issue highlights the need for a simple, tech-assisted solution to minimize food leftovers and, where feasible, facilitate timely redistribution to those in need. **(UNSD Goal:12 – Responsible Consumption and Production)**
4. Urban residential buildings often overlook the use of rooftops for rainwater harvesting, despite recurring water shortages and untapped potential for collection. The absence of simple, cost-effective solutions and public awareness contributes to underutilization, hindering sustainable water conservation efforts. **(UNSD Goal 6 Clean Water and Sanitation)**
5. Urban areas face increasing traffic congestion, leading to longer commute times, increased pollution, fuel consumption, and road accidents. Existing traffic systems are often static, inefficient, and unable to adapt to real-time conditions. There is a growing need for intelligent, real-time traffic management systems that are scalable, cost-effective, and technologically driven. **(UNSD Goal 11: Sustainable Cities and Communities)**
6. Air pollution in urban areas poses serious health risks, especially indoors, where many residents are unaware of the poor air quality due to the absence of affordable monitoring tools. **(UNSD Goal 3: Good Health and Well-being)**



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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	
13211301	Mathematical Foundations for Electronics and Computer Science	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211301	Mathematical Foundations for Electronics and Computer Science	20	20	40	60	2.5	25	--	125

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Rationale:

The study of Laplace Transform and Inverse Laplace Transform equips students with essential tools to analyze and solve differential equations that model real-world continuous-time systems, such as electrical circuits and control systems, enabling accurate prediction of system behavior in time and frequency domains. The Z Transform extends this analysis to discrete-time signals, which are fundamental in designing and analyzing digital filters and signal processing algorithms in embedded systems. Understanding Graph Theory is crucial for modeling and solving problems related to networks, such as routing in computer networks or optimizing circuit layouts in electronics. The concepts of Functions and Mathematical Relations provide a framework for designing logical circuits, finite state machines, and database schemas, which are integral to both hardware design and software development. Finally, the Fundamental Principle of Counting allows students to approach combinatorial problems common in encryption, data encoding, and hardware configuration, enabling efficient computation and security in computing systems. Together, these topics form a foundation that bridges theoretical mathematics with practical applications in electronics and computer science engineering.

Course Objectives:

1. To understand the fundamentals of Laplace transforms for analyzing continuous-time signals and systems.
2. To explain inverse Laplace techniques to retrieve time-domain signals from the s-domain.
3. To understand Z-transform techniques for the analysis of discrete-time signals in digital systems.
4. To explain key concepts of graph theory for modeling structured data and system interconnections.
5. To describe the role of functions and relations in structuring computational and logical systems.
6. To explain combinatorial techniques to count arrangements and selections relevant to computation and design.



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Course Outcomes:

1. Students will be able to apply Laplace transforms to model and analyze electrical circuits and control systems in embedded applications.
2. Students will be able to compute the inverse Laplace transform to determine system behavior in electronic filters and feedback systems.
3. Students will be able to Apply Z-transforms to design and analyze digital filters in DSP and signal reconstruction in microcontrollers.
4. Students will be able to use graph algorithms to solve routing, dependency resolution, and circuit layout problems.
5. Students will be able to analyze relations and functions for designing logical circuits, database schemas, and finite state machines.
6. Students will be able to solve counting problems in encryption, data encoding, and digital circuit design using permutations and combinations.

Prerequisite:

1. Basics of integration and its properties.
2. Definition of sets, Venn diagrams, complements, cartesian products, power sets.

DETAILED SYLLABUS

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at} , $\sin(at)$, $\cos(at)$, $\sinh(at)$, $\cosh(at)$ and t^n , $n \geq 0$. Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by t , Division by t , Laplace Transform of derivatives and integrals (Properties without proof). Evaluation of integrals by using Laplace	05	CO1



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		Transformation.		
		Self-learning Topics: 1. Heaviside's Unit Step function. 2. Laplace Transform. of Periodic functions. 3. Dirac Delta Function.	07	
II	Inverse Laplace Transform	Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. Partial fractions method to find inverse Laplace transform Inverse Laplace transform using Convolution theorem (without proof).	05	CO2
		Self-learning Topics: 1. Applications of Laplace Transforms for solutions to ODE to electrical & electronics circuit problems. 2. Applications to solve initial and boundary value problems involving ordinary differential equations.	07	
III	Z-Transform	Definition and Region of Convergence, Transform of Standard Functions: $\{k^n a^k\}$, $\{a^k\}$, $\{c^k \sin(\alpha k + \beta)\}$, $\{c^k \sinh a k\}$, $\{c^k \cos(\alpha k + \beta)\}$, $\{c^k \cosh a k\}$ Properties of Z Transform: Change of Scale, Shifting Property, Multiplication, and Division by k. Convolution theorem. Inverse Z transform: Partial Fraction Method	05	CO3
		Self-learning Topics: 1. Initial value theorem.	08	



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		2. Final value theorem. 3. Inverse Using Convolution Theorem. 4. Inverse using Binominal expansion. 5. Inverse using long division.		
IV	Graph Theory	Types of graphs, Graph Representation, Sub graphs. 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.	05	CO4
		Self-learning Topics: 1. Network Flow Problems – Understanding flow in networks and its optimization. 2. Graph Coloring Applications in Scheduling – Use of graph coloring in timetabling and resource allocation. 3. Optimization Techniques – Application of graphs in shortest path problems, spanning trees, and clustering. 4. Spanning trees.	08	
V	Functions and Mathematical relations	Types: Injective, Surjective, and Bijective Functions. Composition, Inverse Functions. Real life applications of Functions. Partial Order Relations, Poset, Hasse Diagram, Chain and Anti chains, Lattice, Types of Lattices, Sub lattice.	05	CO5
		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.	08	



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		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.		
VI	Fundamental Principle of Counting	Basic Counting Principle-Sum Rule, Product Rule. Inclusion-Exclusion Principle and Pigeonhole Principle Recurrence relations, Solving recurrence relations	05	CO6
		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.	07	

Text Books:

1. Grewal B. S.: “Higher Engineering Mathematics”, Khanna Publishers, 44th Ed., 2021.
2. Kreyszig E.: “Advanced Engineering Mathematics”, John Wiley & Sons, 10th Ed., 2018.
3. Dass H. K.: “Higher Engineering Mathematics”, S Chand & Company Ltd, 12th Ed., 2004.
4. Narayan S.: “Differential Calculus”, S.Chand Publications, 30th Ed., 2005.
5. Susanna S. Epp, “Discrete Mathematics with Applications”, Cengage Publications, 5th Ed.
6. Ralph P. Grimaldi, “Discrete and Combinatorial Mathematics”, 5th Edition, Pearson Publications.
7. Edgar Goodaire and Michael Parmenter, “Discrete Mathematics and Graph Theory”, 3rd Edition, Pearson Publications.

References:

1. Stewart J.: “Multivariable Calculus” Cengage Publications, 7th Ed., 2019.



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2. Bali N.P and Goyal M.: “A Textbook of Engineering Mathematics” Laxmi Publications, 10th Ed., 2022.
3. Wylie C. R, Barrett L.C.: “Advanced Engineering Mathematics” McGraw Hill Book Co., New York, 6th Ed., 2017.
4. Ramana B.V.: “Higher Engineering Mathematics”, Tata McGraw-Hill Publishing Company Limited, 1st Ed., 2006.
5. Pal S. & Bhunia S. C.: “Engineering Mathematics” Oxford University Press, 3rd Ed., 2016.
6. Kenneth A. Ross, “Discrete Mathematics”, 5th Edition, Pearson Publications.
7. Swapan Kumar Sarkar, “Textbook of Discrete Mathematics”, 9th Edition, S. Chand Publications.
8. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, “Discrete Mathematical Structures”, 6th Edition, Pearson Education.
9. T. Veera Rajan, “Discrete mathematics with Graph Theory and Combinatorics”, McGraw Hill Publications.
10. C. L. Liu “Elements of Discrete Mathematics”, second edition 1985, McGraw-Hill Book Company.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/111/106/111106139/
2.	https://www.youtube.com/watch?v=LGxE_yZYigI
3.	https://www.youtube.com/watch?v=lkAvgVUvYvY
4.	https://www.youtube.com/watch?v=sMYtHaSIXbU
5.	https://www.youtube.com/watch?v=XfmbrUBrs5Q
6	https://nptel.ac.in/courses/106106094
7	https://nptel.ac.in/courses/106108227



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8.	https://nptel.ac.in/courses/106106183
9.	https://nptel.ac.in/courses/106103205

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 purposes.
2. Students must be encouraged to write **at least 10** class tutorials on the 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	
13211302	Electronic Devices and Circuits	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211302	Electronic Devices and Circuits	20	20	40	60	2.5	--	--	100

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Rationale: Electronic Devices and Circuits (EDC) syllabus provides a strong foundation in analog electronics, essential for understanding and designing real-world electronic systems. It covers key topics such as diodes, transistors, amplifiers, and power devices, enabling students to analyze and build basic analog circuits. The course bridges theoretical concepts with practical applications in signal processing, power conversion, and control. This prepares students for advanced studies and industry-oriented projects in electronics and communication engineering.

Course Objectives:

1. To enable students to **identify** different configurations of PN junction diode-based clippers and clampers along with their input-output waveforms and transfer characteristics.
2. To enable students to **explain** the working and mathematical analysis of full-wave center-tapped and bridge rectifiers, and to explain the operation and ripple factor of different filter circuits
3. To enable students to **demonstrate** knowledge of biasing, small-signal models, and design procedures for BJT amplifiers.
4. To enable students to **analyze** and design MOSFET-based circuits, including DC load line, biasing, AC load line, small-signal models, and common-source amplifier configurations.
5. To enable students to **understand** the types, classifications, and working principles of power amplifiers.
6. To enable students to **explain** the construction, characteristics, and applications of power electronic devices.

Course Outcomes:

1. **Demonstrate** Semiconductor applications as clipper and clamper
2. **Analyze** the operation and performance of rectifier and filter circuits
3. **Evaluate** the performance of BJT circuits using DC and AC analysis for various operating conditions.
4. **Apply** DC and AC analysis techniques to design and evaluate MOSFET-based electronic circuits.
5. **Explain** the principles and classifications of power amplifiers, including Class A, B, AB, and C, and describe the operation of power amplifiers using MOSFETs.
6. **Illustrate** the construction, characteristics, and applications of power electronic devices



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	BEEE, Semiconductor Physics		
1	Clippers & Clampers	Theoretical description of basic structure & construction of p n junction diode, symbol, operation under zero bias, forward bias & reverse bias, avalanche breakdown, V-I characteristics & temperature effects (no mathematical analysis or numerical examples). Application of P-N junction diode as clippers & clampers (different types of configurations with input-output waveforms & transfer characteristics; theoretical description & analysis of each circuit; numerical examples)	08	CO1
		Self-Learning: P-N junction formation & energy bands Forward vs reverse bias effects Avalanche vs Zener breakdown Clipper/clamp circuits: types, waveforms Diode applications in real-world electronics	08	
2	Rectifiers & Filters	Rectifiers: Working & mathematical analysis of full – wave center tapped rectifier & bridge type rectifier (mathematical analysis include expressions for the DC / average & RMS output voltage, DC / average & RMS output current & ripple factor; numerical examples included)	07	CO2



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		Filters: Capacitor (C), Inductor (L), Inductor – Capacitor (LC), C-L-C (π) with circuit diagram, waveforms, working / operation & expression for ripple factor (theoretical description only – no mathematical analysis or numerical examples to be included)		
		Self-Learning: Rectifiers • Comparison: Half-wave vs full-wave vs bridge • Efficiency and ripple factor analysis • Effect of transformer turn ratio on output • Diode conduction periods and current paths Filters • Role of capacitors and inductors in smoothing • Designing filters for specific ripple limits • Practical applications in power supplies • Effects of load resistance on filter performance	07	
3	Bipolar Junction Transistor Based Circuits	DC Circuit Analysis: DC load line and region of operation, common bipolar transistor configurations, biasing circuits, bias stability and compensation, analysis and design of biasing circuits. AC Analysis of BJT Amplifiers: AC load line, small signal models (h-parameter model, Hybrid-pi model), graphical analysis, ac equivalent circuits and analysis to obtain voltage	08	CO3



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		gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers. Design of CE Amplifier		
		Self-Learning: Select biasing method (usually voltage divider). Choose R_c and R_e for gain and stability. Ensure Q-point is at the center of the active region. Decide bypass capacitor for full AC gain. Calculate coupling capacitor values for desired frequency response. Understand frequency response , bandwidth.	08	
4	MOSFET Based Circuits	DC Circuit Analysis: DC load line and region of operation, common MOSFETs configurations, analysis and design of biasing circuits AC Analysis: AC load line, small-signal model of MOSFET at high and low frequency and its equivalent circuit, small-signal analysis of MOSFET amplifiers, common-source, source follower, common gate. Design of CS Amplifier using MOSFETS	08	CO4
		Self-Learning: DC Analysis: Understand the DC load line, MOSFET operating regions (cutoff, triode, saturation), and biasing (voltage divider preferred). AC Analysis: Learn AC load line, small-signal model (low/high frequency), and amplifier	08	



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		configurations (common-source, source follower, common gate).		
5	Power Amplifier	Introduction to power amplifiers, difference between voltage and power amplifiers. Classification of Class A, Class-B, Class- AB, Class-C power amplifiers, power amplifier using MOSFET	05	CO5
		Self-Learning: Understand the difference between voltage and power amplifiers in terms of output power and load handling. Study Class A, B, AB, and C amplifier operation, efficiency, and linearity characteristics. Learn how MOSFETs are used in power amplifier circuits, especially in Class AB and high-efficiency designs.	05	
6	Power Electronic Devices	Introduction to power electronic devices and its needs. Introduction, scope and application, construction and characteristics of thyristors, power MOSFET, IGBT, IGCT and GTO. Applications of power electronic devices Case Study 1: "Design of a Low-Cost Analog Power Supply and Signal Conditioner for LED-based Torch Circuit" Case Study 2: "Analog Front-End Design for Soil Moisture Sensor in Smart Agriculture" Case Study 3: "Design of Analog Audio Preamplifier Circuit for Mobile or Bluetooth Speaker"	06	CO6
		Self-Learning:	06	



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		Understand the need for power electronic devices in efficient control and conversion of electrical power. Study the construction, characteristics, and switching behavior of thyristors, power MOSFETs, IGBTs, IGCTs, and GTOs. Explore applications of these devices in motor drives, power supplies, inverters, converters, and renewable energy systems.		
	Total		90	

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Boylestead, "Electronic Devices and Circuit Theory", Pearson Education
3. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press
4. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
5. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage Hughes, Newnes Publisher.

References:

1. Millman and Halkies, "Integrated Electronics", Tata McGraw Hill.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits
3. Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.
4. Muhammad H. Rashid, "Power Electronics - circuits, devices and applications", Prentice Hall of India, 2nd edition.
5. P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.

Online References:

NPTEL courses on microelectronics: Devices to circuits



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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	
13211303	Computer Organization & architecture	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211303	Computer Organization & architecture	20	20	40	60	2.5	--	--	100

Rationale: Computer Organization and Architecture (COA) provides essential knowledge of how computer systems function at the hardware level. It covers topics like CPU design, memory systems, instruction execution, and input/output mechanisms. For Electronics and Computer Science Engineering students, COA bridges hardware and software, enabling a

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deeper understanding of system performance, embedded systems, and low-level programming. This foundation is crucial for advanced studies and careers in system design, hardware development, and software optimization.

Course Objectives:

1. To enable students to **Describe** the basic components of a computer and explain different architecture models and number representations.
2. To enable students to **Analyze** instruction formats and control unit designs; compare RISC and CISC architectures.
3. To enable students to **Explain** the memory hierarchy and apply cache and virtual memory techniques in system design.
4. To enable students to **Illustrate** I/O communication methods and differentiate between various interfacing techniques.
5. To enable students to **Understand** parallel computing models and evaluate pipelining performance and hazards.
6. To enable students to **Examine** advanced processor features like GPUs and multicore systems and discuss their real-world applications.

Course Outcomes:

1. **Explain** basic computer architecture and number systems.
2. **Analyze** processor structure and instruction execution.
3. **Apply** memory organization concepts in system design.
4. **Demonstrate** I/O handling and interfacing techniques.
5. **Evaluate** pipeline and parallel processing performance.
6. **Examine** modern processor features like GPUs and multicore systems.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Digital Electronics, Data structure, fundamental concept of processing		



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1	Introductory Concepts	1.1 Basic Building blocks of a Computer, Moore's law, Evolution of x86 Computers, Von Neumann model, Harvard Model, Performance measures 1.2 Number representation: Floating-point representation, Floating point arithmetic, IEEE 754 floating point number representation 1.3 Booth's Multiplier, Restoring and Non-Restoring Division	07	CO1
		Self-Learning: - History and Future of Moore's Law - Comparison: Von Neumann vs Harvard Architectures in Modern CPUs and Microcontrollers - Floating Point Precision Errors in Scientific Computing - IEEE 754 Format – Handling Subnormal Numbers and Exceptions - Binary Multipliers in Hardware Design: Beyond Booth's Algorithm - Real-World Use of Restoring/Non-Restoring Division in Embedded Systems	07	
2	Processor Organization	2.1 Instruction format, Instruction cycle, Instruction set types, Addressing Modes 2.2 Data path Organization (including Control sequences) 2.3 Control Unit Design: Hardwired and Microprogrammed, Nano-programming 2.4 CISC vs RISC: Design philosophy and issues	09	CO2



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		Self-Learning: • How Instruction Set Design Affects Compiler Optimizations • RISC-V: Open Source Instruction Set Architecture and Its Growing Popularity • Evolution of Microprogramming – Why it's Still Relevant in Niche CPUs • Instruction Pipeline in Modern ARM Processors • Real-world Example of Addressing Modes in Assembly Programming • VLIW (Very Long Instruction Word) Architecture – An Alternative Design Approach	09	
3	Memory Organization	3.1 Types of memories, Performance parameters of a Memory system, Memory Hierarchy, Memory Interleaving 3.2 Cache memory concepts: Principles of locality of Reference, Cache mapping techniques, Cache architectures, Cache coherency (Brief Discussion on MESI model) 3.3 Virtual management concepts: Paging, Segmentation, Page Replacement policies 3.4 Case Study: Virtual Memory management in Pentium Processor	09	CO3



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		Self-Learning: • DRAM vs SRAM: Use Cases and Architectural Differences • Modern Cache Architectures: Inclusive vs Exclusive Caches • Translation Lookaside Buffer (TLB) – Role in Virtual Memory • Memory Interleaving Techniques in Multi-Channel RAM • Advanced Paging Techniques in 64-bit Systems • Case Study Extension: Comparing Virtual Memory in Linux vs Windows	09	
4	I/O Organization	4.1 I/O interfacing: Handshaking, Interrupt handling, Direct memory Access (DMA) 4.2 I/O Buses: Protocols, Arbitration	05	CO4
		Self-Learning: • USB vs PCIe: Protocol Comparison and Use in Modern Devices • Interrupt Handling in Linux Kernel (Advanced Study) • Role of DMA in High-Speed I/O (e.g., SSDs and GPUs) • Comparison of Synchronous and Asynchronous I/O Techniques • NVMe Storage Protocol – Replacing SATA in High-Performance Systems	05	
5	Parallel processing	5.1 Introduction to Parallel processing, Flynn's Classification, Amdahl's Law 5.2 Pipelining, Pipeline Performance metrics, Pipeline Hazards and Solutions	07	CO5
		Self-Learning: • Flynn's Taxonomy: Where Do GPUs and TPUs Fit In?	07	



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		• Instruction Level Parallelism (ILP) in Superscalar Architecture • Pipelining in RISC-V vs x86 CPUs • Real-world Pipeline Hazards and How Modern CPUs Solve Them • Amdahl's Law vs Gustafson's Law in Scaling Multicore Systems		
6	Enhancements of Advanced Processor Architectures	6.1 Superscalar processors, Branch Prediction logic, GPUs, Clusters, Multi-core processors 6.2 NVIDIA GPU Case study and Programming Model Case Study 1: "Intel vs ARM Architectures – A Comparative Study" Case Study 2: "Cache Optimization in High-Performance Computing" Case Study 3: "Virtual Memory Management in Linux Systems"	08	CO6
		Self-Learning: • Modern Branch Prediction Algorithms (e.g., TAGE, GShare) • Introduction to CUDA Programming for NVIDIA GPUs • Tensor Cores in NVIDIA GPUs: Role in AI Workloads • ARM Big.LITTLE Architecture in Mobile CPUs • Multicore vs Manycore Architectures (Intel Xeon vs NVIDIA GPUs) • Performance Bottlenecks in Superscalar vs VLIW CPUs	08	
	Total		90	



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Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill, 2002.
3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 9th Edition,

References:

1. P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.
2. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, Tata McGraw-Hill.
3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann, 1998.
4. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
5. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition

Online References:

NPTEL course: https://onlinecourses.nptel.ac.in/noc22_cs88/preview

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R-2025- S.E (Sem-III) Electronics and Computer Science

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	
13211304	Data Structures and Algorithms	3	0	-	45			45	90	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211304	Data Structures and Algorithms	20	20	40	60	2.5			100

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Rationale: Data structures and algorithms are essential for efficiently organizing and processing data, enabling the development of scalable and optimized software solutions.

Course Objectives:

1. **To introduce** fundamental data structures and their applications in problem-solving.
2. **To develop** an understanding of algorithm design techniques like recursion, divide-and-conquer, and greedy methods.
3. **To implement** various data structures such as arrays, linked lists, stacks, queues, trees, heaps, and graphs.
4. **To analyze** the efficiency of algorithms using time and space complexity (Big-O notation).
5. **To apply** appropriate data structures for various real-world computing problems.
6. **To prepare** students for advanced topics in algorithms and competitive programming.

Course Outcomes:

1. Implement various linear data structures.
2. Implement various nonlinear data structures.
3. Select appropriate sorting and searching techniques for a given problem and use it.
4. Develop solutions for real world problems by selecting appropriate data structure and algorithms.
5. Analyze the complexity of the given algorithms.



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6. Demonstrate problem-solving skills through implementation of data structure-based solutions in the projects or lab exercises

Prerequisite: C Programming

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Data Structures	Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of array, Static arrays vs Dynamic Arrays, structures. Introduction to Analysis of Algorithms, characteristics of algorithms, Time and Space complexities, Asymptotic notations.	09	CO1
		Self-learning Topics: Linked Lists application Case Study: Implementing a Music Playlist Manager	09	
II	Stack and Queues	Introduction, Basic Stack Operations, Representation of a Stack using Array, Applications of Stack – Well form-ness of Parenthesis, Infix to Postfix Conversion and Postfix Evaluation. Queue, Operations on Queue, queue-Round Robin Algorithm	07	CO2
		Self-learning Topics: "Implementing a Circular Queue and its Applications in Real-Time Systems"	07	

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		Case Study: "Expression Evaluation and Syntax Parsing in Compilers using Stacks"		
III	Linked List	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List (SLL), Operations on Singly Linked List: Insertion, Deletion, reversal of SLL, Print SLL. Circular Queue, concept of priority Queue, Applications of Circular Linked List	07	CO3
		Self-learning Topics: Implementing and Comparing Different Types of Linked Lists (Singly, Doubly, Circular) Case Study: "Dynamic Memory Allocation in Operating Systems using Linked Lists"	07	
IV	Trees and Graphs	Introduction, Tree Terminologies, Binary Tree, Types of Binary Tree, Representation of Binary Trees, Binary Tree Traversals, Binary Search Tree Operations on Binary Search Tree, Graph Terminologies, Representation of graph (Adjacency matrix and adjacency list), Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS)	09	CO4
		Self-learning Topics: Understanding and Implementing Binary Search Trees (BST) with Real-Time Insertion and Deletion	09	

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		Case Study: Hierarchical File System Representation Using Tree		
V	Sorting and Searching	Introduction to Searching: Linear search, Binary search, Sorting: Internal VS. External Sorting, Sorting Techniques: Bubble, Insertion, selection, Quick Sort, Merge Sort, Comparison of sorting Techniques based on their complexity. Hashing Techniques, Different Hash functions, Collision & Collision resolution techniques:Linear and Quadratic probing, Double hashing.	07	CO5
		.Self-learning Topics: Comparative Study and Implementation of Sorting Algorithms (Bubble, Insertion, Merge, Quick) Case Study: Optimizing E-Commerce Product Listings Using Sorting and Searching Algorithms	07	
VI	Greedy method and Dynamic Programming	Knapsack Problem, Minimum Cost Spanning Trees, Longest Common Subsequence	06	CO6
		Case Study: Optimizing Relief Material Distribution using the Knapsack Problem	06	
Total			90	

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R-2025- S.E (Sem-III) Electronics and Computer Science

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education
2. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson
3. Data Structures using C, Reema Thareja, Oxford
4. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
5. Data Structures: A Pseudocode Approach with C, Richard F. Gilbert& Behrouz A. Forouzan, Second Edition, CENGAGE Learning

References:

1. Data Structure Using C, Balagurusamy.
2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.
4. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.
5. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.
6. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106102064
2.	Coursera link: https://www.coursera.org/specializations/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	
13212305	Electronic Devices and Circuits Lab	--	--	2	-	-	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212305	Electronic Devices and Circuits Lab	--	--	--	--	25	25	50

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R-2025- S.E (Sem-III) Electronics and Computer Science

Lab Objectives:

Lab course aims to

1. To provide hands-on experience with basic electronic devices and circuits.
2. To understand the characteristics and operation of diodes, BJTs, and MOSFETs.
3. To analyze and measure key circuit parameters experimentally.
4. To introduce circuit simulation using software tools like SPICE.
5. To design and test amplifiers and biasing circuits.
6. To study the characteristics and applications of power electronic devices.

Lab Outcomes:

After the successful completion students should be able to

1. Analyze the operation of diode-based circuits including clippers, clampers, and rectifiers.
2. Simulate rectifier and filter circuits using SPICE and interpret the output waveforms.
3. Design and evaluate BJT amplifier circuits based on AC and DC analysis.
4. Compare and analyze biasing and amplifier configurations using MOSFETs.
5. Verify amplifier performance using theoretical calculations, simulation, and hardware.
6. Interpret and study the static characteristics of power devices like SCR, TRIAC, and DIAC.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	BEE Lab, Semiconductor Physics Lab		
1	Study of Clipping Circuits (Series and Shunt Clippers with and without bias – observe input/output on CRO).	2	LO1



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2	Study of Clamping Circuits (Positive, Negative, and Biased Clampers – analyze waveforms).	2	LO1
3	Study of Full-Wave Center-Tapped Rectifier : Observe waveforms, measure V _{dc} and ripple.	2	LO2
4	Study of Full-Wave Bridge Rectifier : Compare with center-tap; observe and measure waveforms.	2	LO2
5	Implementation of C, L, LC, and π Filters and observation of their smoothing effect on CRO.	2	LO2
6	Compare different Biasing Circuits of BJT	2	LO3
7	To perform AC, DC, Transient and frequency response of single stage CE amplifiers.	2	LO3
8	Design CE amplifier for a given specification	2	LO3
9	Compare different Biasing Circuits of MOSFETS	2	LO4
10	To perform AC, DC, Transient and frequency response of single stage CS MOSFET amplifiers.	2	LO4
11	Construction and Testing of Class A Power Amplifier : Bias a transistor in the active region; plot input/output waveforms and calculate efficiency.	2	LO5
12	Class B Push-Pull Amplifier : Build and test a Class B configuration using complementary transistors; observe crossover distortion.	2	LO6
13	Study of static characteristics of SCR	2	LO6
14	Study of static characteristic of Triac and Diac	2	LO6



15	Triggering Methods of SCR using Gate Signal: Study various gate triggering techniques (R, RC, UJT-based).	2	LO6

Text Books:

1. David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.
2. Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", 2nd edition, PHI, 1995
3. Mithal. G.K, "Practicals in Basic Electronics", G K Publishers Private Limited, 1997.

Online Resources:

Sr. No.	Website Name
1.	https://www.allaboutcircuits.com/
2.	https://www.tinkercad.com/
3.	https://www.circuitlab.com/

Laboratory Assessment:**Assessment:**

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

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

Practical/ Oral Exam: An Oral and practical examination will be held based on the above syllabus.

Term Work: Term Work shall consist of at least 8 to 10 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)



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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	
13212306	Data Structures and Algorithms Lab	--	--	2	-	-	30	--	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212306	Data Structures and Algorithms Lab	--	--	--	--	25	25	50

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Lab Objectives:

1. **To provide hands-on experience** in implementing basic and advanced data structures using a programming language (e.g., C/C++, Python, Java).
2. **To enable students** to implement linear data structures such as arrays, stacks, queues, and linked lists.
3. **To develop proficiency** in designing and implementing non-linear data structures like trees, heaps, and graphs.
4. **To enhance understanding** of sorting and searching algorithms through practical coding.
5. **To train students** to evaluate algorithm performance in terms of time and space complexity.
6. **To build confidence** in applying data structures for solving real-world computational problems.

Lab Outcomes:

1. Students will be able to implement linear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.
2. Students will be able to implement nonlinear data structures & will be able to handle operations like insertion, deletion, searching and traversing on them.
3. Students will be able to choose appropriate data structure and apply it in various problem domains.
4. Students will be able to select appropriate searching techniques for given problems.
5. Students will be able to Compare and contrast different data structures for solving a given problem effectively.
6. Apply appropriate data structures and algorithms in mini-projects or case studies to solve practical problems.



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List of Experiments.

Sr No	List of Experiments	Hrs
01	*Implement Stack ADT using array	2
02	*Convert an Infix expression to Postfix expression using stack ADT	2
03	Evaluate Postfix Expression using Stack ADT	2
04	Check whether parentheses are balanced or not.	2
05	*Implement Linear Queue ADT using array	2
06	Implement Circular Queue ADT using array	2
07	Implement Priority Queue ADT using array	2
08	*Implement Singly Linked List ADT	2
09	Implement Doubly Linked List ADT	2
10	*Implement Stack ADT using Linked List	2
11	*Implement Linear Queue ADT using Linked List	2
12	*Implement Depth First Search and Breadth First Search Graph Traversal technique	2
13	Write a program to Find the Missing Number	2
14	Count 1's in a sorted binary array	2
15	Find the closest pair from two sorted arrays	2

Sr No	List of Assignments / Tutorials	Hrs
01	Practice problems on asymptotic notation (Big O, Theta, Omega).	1



02	Compare complexity of recursive vs. iterative algorithms.	1
03	Solve problems on bubble, insertion, selection, merge, and quick sort.	1
04	Analyze best, average, and worst-case time complexities.	1
05	Solve problems like Tower of Hanoi, binary search, and merge sort using recursion.	1
06	Solve problems On binary search,	1
07	Solve problems On binary merge sort	1
08	Solve problems On binary Quick sort	1

Text Books:

1. Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education
2. Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson
3. Data Structures using C, Reema Thareja, Oxford
4. C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
5. Data Structures: A Pseudocode Approach with C, Richard F. Gilberg& Behrouz A. Forouzan, Second Edition, CENGAGE Learning

References:

1. Data Structure Using C, Balagurusamy.
2. Data Structures using C and C++, Rajesh K Shukla, Wiley - India
3. ALGORITHMS Design and Analysis, Bhasin, OXFORD.
4. Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.
5. Computer Algorithms by Ellis Horowitz and Sartaj Sahni, Universities Press.
6. Data Structures, Adapted by: GAV PAI, Schaum's Outlines.



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106102064
2.	Coursera link: https://www.coursera.org/specializations/algorithms

Laboratory Assessment:

Assessment:

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

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

Practical/ Oral Exam: An Oral and practical examination will be held based on the above syllabus.

Term Work: Term Work shall consist of at least 8 to 10 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)



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

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	
9951137 XX	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	Total.					
9951137 XX	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	Total					
98431308	Entrepreneurship Development	--	--	--	--	--	25	--	25

Rationale :

Entrepreneurship is a crucial skill in the 21st century, fostering innovation, self-employment, and economic development. This course is designed to equip students with practical entrepreneurial competencies such as ideation, business model development, financial planning, legal frameworks, and pitching.

Course Objectives:

1. Understand and explain the fundamentals of entrepreneurship and startup ecosystems.
2. Generate, validate, and refine business ideas using structured techniques.
3. Develop comprehensive business plans and financial strategies.

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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	
II	Business	Ideation Techniques: Design Thinking,	5	CO2



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	Idea Generation & Validation	Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.		
		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	
V	Marketing & Digital Presence	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models.	5	CO5

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		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:

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,

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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	Total					
98451309	Environmental Science	20	20	40	60	2.5	--	--	100

Rationale :

Environmental Science provides a multidisciplinary perspective to understand, analyze, and solve ecological challenges. With growing global concern over climate change, pollution, and sustainable development, it is essential to equip students with the knowledge, skills, and values needed to contribute to sustainable solutions.

Course Objectives:

1. To understand the interrelationship between human activities and the environment.
2. To explore natural ecosystems and biodiversity conservation techniques.
3. To identify causes, effects, and mitigation strategies for various types of environmental pollution.

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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 Studies	Definition, scope and importance. Need for public awareness. Role of information technology in environment and human health. Human population and the Environment. Population growth, variation among nations. Population Explosion- family welfare program. Environment and	5	CO1



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		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 the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers,	5	CO3



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		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: a. Air pollution b. Water pollution c. 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
		Self-learning Topics: Greenhouse gases Case study: Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	5	

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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		

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
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,

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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	
13612310	IDEA LAB - III (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13612310	IDEA LAB - III (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.



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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.



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- 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.



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

b) Implementation of Subject-Term Work Mapping within Projects

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

Implementation Notes:

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

2) Guidelines for Assessment

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

*R-2025- S.E (Sem-III) Electronics and Computer Science***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:



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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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R-2025- S.E (Sem-IV) Electronics and Computer

SEM IV

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R-2025- S.E (Sem-IV) Electronics and Computer

ECS-Semester-4

Theme: “Innovating urban spaces for people and the planet”

- **SDG 11: Sustainable Cities and Communities**
- **SDG 9: Industry, Innovation and Infrastructure**
- **SDG 13: Climate Action**
- **SDG 6: Clean Water and Sanitation**
- **SDG 3: Good Health and Well-being**
- **SDG 12: Responsible Consumption and Production**

Keywords: water quality, waste management, lifestyle diseases, air quality index, entrepreneurship.

Description: The theme “Innovating Urban Spaces for People and the Planet” envisions a transformation of city systems to better serve human needs while ensuring environmental sustainability. In rapidly growing urban regions like Mira-Bhayander, rising challenges such as population pressure, pollution, waste management, water quality issues, public health risks, and vulnerability to natural or man-made disasters, demand smart, integrated, and sustainable solutions. This theme highlights the role of digital innovation, including real-time monitoring and data-driven environmental tracking, in building cleaner, healthier, and more resilient cities. It also promotes inclusive urban development by empowering local entrepreneurs, artisans, and communities through technology platforms and networking tools. By tackling critical issues such as clean water access, air quality, waste reduction, public health, disaster preparedness, and economic inclusion, this approach seeks to create urban spaces that enhance quality of life while protecting natural ecosystems. Ultimately, it supports global sustainability goals by fostering a balance between technological advancement, environmental stewardship, and social equity

Problem Statement:

1. In metropolitan areas, the quality of water supplied by municipal corporations is often inconsistent and, at times, unsafe. This irregularity in water treatment and distribution can result in contamination, posing significant health risks to the

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population. Poorly treated or contaminated water can lead to a surge in waterborne diseases such as cholera, typhoid, and gastrointestinal infections. Given the gravity of these risks, there is a pressing need for effective monitoring systems and real-time alert mechanisms to ensure the consistent delivery of safe and clean drinking water to all residents **(UNSD GOAL 6: Clean Water and Sanitation)**

2. Urban areas generate thousands of tonnes of waste daily, including solid, medical, plastic, metal, and electronic waste. The lack of proper disposal and effective segregation leads to severe environmental pollution and public health hazards. To ensure a cleaner, greener, and more sustainable urban future, there is a pressing need for intelligent waste management systems that emphasize reduction, reuse, and recycling. **(UNSD GOAL 12: Responsible Consumption and Production)**
3. Lifestyle-related diseases such as diabetes, hypertension, and heart conditions are increasingly affecting large segments of the population. A significant number of individuals remain unaware of early warning signs, leading to delayed diagnosis and treatment. This often results in the progression of disease and the onset of serious complications. Promoting awareness and ensuring accessible health information and monitoring tools are critical steps toward early detection, timely intervention, and improved long-term care. To address this growing concern, digital health platforms, mobile apps, and wearable devices can be used to monitor vital signs, track symptoms, and provide personalized health alerts. **(UNSD GOAL 3: Good Health and Well-being)**
4. Air pollution is a persistent challenge in metropolitan cities, significantly impacting the health and well-being of millions. The Air Quality Index (AQI) is a vital tool for tracking pollution levels and informing the public, yet gaps in timely data collection and communication hinder its effectiveness. To mitigate pollution-related risks, there is a clear need for advanced real-time monitoring systems and targeted community awareness initiatives. Deploying smart sensors for continuous air quality monitoring, integrating data into public alert systems, and promoting eco-friendly practices through education campaigns can help improve air quality and safeguard public health. **(UNSD GOAL 13: Climate Action)**
5. In densely populated cities there is fear of manmade/natural disaster hence there is need for efficient alert system for people by which human lives can be saved. Create a multi-platform emergency alert system using mobile apps, SMS, and public display boards powered by real-time data (earthquake, flood, fire sensors) for city disaster preparedness. Strengthen resilience of urban areas to natural and man-made disasters. **(UNSD GOAL 13: Climate Action, UNSD GOAL 11: Sustainable Cities and Communities).**

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6. Many small entrepreneurs and artisans in local communities struggle to reach wider markets due to limited resources and networking opportunities. Identifying and supporting these individuals through a dedicated platform can help showcase their products and skills. By connecting them with customers, suppliers, and collaborators, such a platform can boost their business growth and promote sustainable local economies. Empowering these entrepreneurs contributes to inclusive development and strengthens community resilience. **(UNSD GOAL 9: Industry, Innovation and Infrastructure)**



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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	
13211401	Sampling Theory and Optimization	2	1	--	30	15	--	45	90	3

Course Code	Course Name	Theory					Ter m wor k	Prac t / Or al	Total
		Internal Assessment			End Semester Exam	Exam Duration (in Hrs)			
		IAT-I	IAT-II	Total					
13211401	Sampling Theory and Optimization	20	20	40	60	2.5	25	--	125

Rationale:

In the field of Electronics and Computer Science Engineering, understanding and applying statistical and optimization techniques is essential for designing efficient and reliable systems. Large and small sample tests enable students to analyze data correctly depending on the sample size, such as testing the performance of hardware components or network delays. The Chi-square and F-tests are vital for assessing relationships in categorical data and comparing variances, which are commonly encountered in quality control and hardware testing. Optimization methods like the Simplex Method and Duality help solve real-world resource allocation problems, such as optimizing computing



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resources or bandwidth under various constraints. For more complex scenarios involving nonlinear constraints, the Kuhn-Tucker conditions provide necessary criteria for optimal solutions, often seen in power-efficient circuit design. Markov Chains offer a powerful framework for modeling stochastic systems like network traffic or error correction processes, where future states depend only on the current condition. Finally, Queuing Theory aids in analyzing and improving systems involving waiting lines, such as task scheduling in processors or packet management in routers, ensuring smooth and efficient operations. Together, these topics build a strong foundation for engineering students to tackle practical challenges in their field.

Course Objectives:

1. To explain hypothesis testing techniques for analyzing large and small data samples in electronic and computing systems.
2. To understand the application of Chi-square and F-tests for independence and variance comparison in system data.
3. To describe linear optimization methods to allocate computing resources efficiently.
4. To explain nonlinear constrained optimization techniques applicable to electronic circuit design and software optimization.
5. To understand markov chains for modeling stochastic processes in communication and computer systems.
6. To describe queuing models to analyze delays and throughput in computer networks and electronic systems.

Course Outcomes:

1. Students will be able to evaluate system performance or signal characteristics using Z-tests and t-tests.
2. Students will be able to analyze categorical data or variance in hardware or software performance using Chi-square and F-tests.
3. Students will be able to solve linear programming problems for optimizing resource allocation using simplex method and duality concepts.
4. Students will be able to apply Kuhn-Tucker conditions to solve constrained nonlinear optimization problems in engineering design.
5. Students will be able to analyze state transitions in systems such as error correction or network protocols using Markov chain models.



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6. Students will be able to evaluate system performance parameters like waiting time and queue length using queuing theory.

Prerequisite:

1. Basic Probability Theory, Matrix Algebra.

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. 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)	05	CO1
		Self-learning Topics: 1. Estimate parameters of a population. 2. Test of significance of large samples, Proportion test. 3. Difference between the means of two large samples.	08	
II	Sampling theory-II	Chi-square test: Test of goodness of fit and independence of attributes (Contingency table) including Yate's Correction. Analysis of variance: F-test (significant difference between variances of two samples).	05	CO2
		Self-learning Topics: 1. ANOVA: One way classification, 2. ANOVA: Two-way classification (short-cut	08	



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		method).		
III	Linear Programming Problems	Types of solutions, Standard and Canonical of LPP, Basic and Feasible solutions, slack variables, surplus variables. Simplex method. Duality, Dual of LPP. Dual Simplex Method.	05	CO3
		Self-learning Topics: 1. Artificial variable method, Big M method. 2. Sensitivity Analysis, Two-Phase Simplex Method, Revised Simplex Method.	08	
IV	Nonlinear Programming Problems	NLPP with one equality constraint (two or three variables) using the method of Lagrange's multipliers NLPP with one inequality constraint (two variables): Kuhn-Tucker conditions.	05	CO4
		Self-learning Topics: 1. NLPP with one equality constraint (three variables) using the method of Lagrange's multipliers 2. NLPP with one inequality constraint (three variables): Kuhn-Tucker conditions	07	
V	Markov Chains	Introduction to Markov Chains Transition Probability matrix, Transition Diagram Homogeneous Markov Chains Chapman-Kolmogorov Equations for discrete Markov chains.	05	CO5
		Self-learning Topics: 1. Initial Conditions 2. Classification of states	07	



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		3. Semi-Markov Chains 4. Markov Processes State Space and Continuous time.		
VI	Queuing Theory	Introduction to Queuing Systems Birth-Death Processes & M/M/1 Queues M/M/c and Finite Queue Models M/G/1 and G/G/1 Queues Queuing Networks	05	CO6
		Self-learning Topics: 1. Priority Queues. 2. Queueing Disciplines. 3. Retrial Queues & Balking/Reneging 4. Queuing with Server Vacations	07	

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

Online References:Assessment:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/117/103/117103017/
2.	https://archive.nptel.ac.in/courses/111/102/111102111/

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 purposes.
2. Students must be encouraged to write **at least 10** class tutorials on the 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 a 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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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	
13211402	Analog Electronics	3		--	45	-	--	45	90	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
13211402	Analog Electronics	20	20	40	60	2.5	--	--	100

Rationale: Analog Electronics is a fundamental subject that equips students with the essential principles required to analyze, design, and implement electronic circuits used in real-world applications. The course covers key topics such as amplifier configurations, frequency response, feedback systems, oscillators, and waveform generators using BJTs, MOSFETs, and operational amplifiers. It bridges theoretical concepts with practical

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circuit behavior, laying a strong foundation for advanced studies in embedded systems, VLSI, instrumentation, and communication systems.

Course Objectives:

1. To enable students **to explain** the frequency response of MOSFET amplifiers and analyze the effect of various capacitances on amplifier performance.
2. To enable students **to illustrate** the working of differential amplifiers and operational amplifiers, including their DC and AC behavior.
3. To enable students to understand the internal architecture, characteristics, and practical parameters of operational amplifiers.
4. To enable students to describe the role of feedback in amplifiers and differentiate between open-loop and closed-loop configurations.
5. To enable students to analyze and design sinusoidal oscillators and waveform generators using op-amps.
6. To enable students **to apply** op-amp-based circuits in linear and non-linear applications such as adders, integrators, comparators, and timers.

Course Outcomes:

1. **Analyze** the frequency response of MOSFET amplifiers considering the effect of capacitances
2. **Evaluate** MOSFET differential amplifiers under DC and AC conditions and determine CMRR.
3. **Explain** op-amp configurations and the impact of feedback on gain and stability.
4. **Design and Analyze** RC-based oscillator circuits and describe the working of waveform generators.
5. **Implement** linear op-amp circuits like adders, integrators, and amplifiers.
6. **Interpret** nonlinear op-amp circuits like comparators, Schmitt triggers, and 555 timer



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
	Prerequisite	Electronic Devices and Circuits		
1	Frequency Response of MOSFET Amplifiers	Low frequency response & analysis, effect of the coupling, bypass & load capacitances on single stage MOSFET amplifier for common source (CS) configuration. High frequency response & analysis, effect of parasitic capacitances on MOSFET amplifiers, high frequency equivalent circuit of MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth (mathematical analysis & numerical examples included). Introduction to multi-stage amplifiers – need & necessity, different types of couplings (DC, R-C & transformer) with advantages & disadvantages, the MOSFET Cascode amplifier (theoretical description only)	08	CO1
		Self Learning: Simulate and analyze MOSFET amplifiers to study the effects of capacitors and frequency response. Practice numerical problems and apply theoretical concepts like Miller's theorem and bandwidth calculation. Explore multi-stage amplifiers by comparing different coupling methods and understanding cascode configuration through circuit analysis.	08	



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2	Differential Amplifier and Op-amp	Basic MOSFET differential amplifier, DC characteristics, transfer characteristics, small signal (AC) analysis of only dual input balanced output (DIBO) for differential mode gain & common mode gains, Common mode rejection ratio (CMRR) & input resistance / impedance. MOSFET differential amplifier with an active load (theoretical description & only mathematical analysis (no numerical examples). The ideal operational amplifier (op-amp), internal block diagram of op-amp, characteristics of op-amp, ideal & practical op-amp parameters / specifications (no detailed description or any Analysis), mathematical model of op-amp, IC 741 op-amp with pin diagram & description.	07	CO2
		Self Learning: Analyze and simulate a MOSFET differential amplifier (DIBO) to understand DC, AC behavior, differential gain, common-mode gain, CMRR, and input impedance. Study and derive theoretical expressions for a differential amplifier with active load. Review and sketch op-amp concepts: internal block diagram, ideal vs practical parameters, mathematical model, and IC 741 pin configuration. • Practical applications in power supplies. • Effects of load resistance on filter performance	07	



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3	Op-amp and Feedback	Open loop & closed loop configurations (theoretical description only), the concept of virtual ground & virtual short. Basic concepts of feedback, Types of feedback – positive and negative and its effect on gain (block diagram and derivation of gain expected). Types of negative feedback – voltage series, voltage shunt, current series & current shunt (block diagram and derivation expected), the op-amp inverting amplifier & op-amp noninverting amplifier (mathematical analysis for derivation of output voltage only, numerical examples & designing	08	CO3
		Self Learning: Understand and compare open-loop vs. closed-loop op-amp configurations and the concepts of virtual ground and virtual short through diagrams and simulations. Study feedback types , draw block diagrams, and derive gain formulas for positive and negative feedback. Explore negative feedback configurations (voltage/current series/shunt) with theoretical analysis and gain derivations. Analyze and design inverting and non-inverting op-amp circuits using mathematical derivations and simulations.	08	



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4	Oscillators and Waveform Generator	DC Circuit Analysis: DC load line and region of operation, common MOSFETs configurations, analysis and design of biasing circuits AC Analysis: AC load line, small-signal model of MOSFET at high and low frequency and its equivalent circuit, small-signal analysis of MOSFET amplifiers, common-source, source follower, common gate. Design of CS Amplifier using MOSFETS	08	CO4
		Self Learning: DC Analysis: Understand the DC load line, MOSFET operating regions (cutoff, triode, saturation), and biasing (voltage divider preferred). AC Analysis: Learn AC load line, small-signal model (low/high frequency), and amplifier configurations (common-source, source follower, common gate).	08	
5	Applications of Op-amp	Adder, summing amplifier, averaging circuit, subtractor, integrator (ideal), differentiator (ideal), difference amplifier, current amplifier & 3 op-amp instrumentation amplifier (only mathematical analysis for derivation of output voltage with numerical examples & designing included). Current to voltage converters (I to V) & voltage to current converters (V to I) – floating load & grounded load (mathematical analysis only – no numerical).	05	CO5



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		Self Learning: Study and derive output voltage formulas for adder, subtractor, integrator, differentiator, averaging, difference, and current amplifier circuits with numerical examples and design tasks. Analyze the 3-op-amp instrumentation amplifier with full mathematical derivation. Understand and derive expressions for current-to-voltage and voltage-to-current converters for both floating and grounded loads (theoretical only)..	05	
6	Non-Linear Integrated Circuits	Comparators: Inverting comparator, non-inverting comparator, zero crossing detectors, window detector. Schmitt Triggers: Inverting Schmitt trigger, non-inverting Schmitt trigger IC 555 Timer: pin configuration and block diagram, Operation in astable and monostable multivibrator with mathematical analysis & numerical examples, applications in astable and monostable configurations. Case Study: Design of a Smart Temperature Monitoring Circuit Using Analog Components	06	CO6
		Self Learning: Study and derive output voltage formulas for adder, subtractor, integrator, differentiator, averaging, difference, and current amplifier circuits with numerical examples and design tasks.	06	



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		Analyze the 3-op-amp instrumentation amplifier with full mathematical derivation. Understand and derive expressions for current-to-voltage and voltage-to-current converters for both floating and grounded loads (theoretical only).		
	Total		90	

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition
2. Boylestead, "Electronic Devices and Circuit Theory", Pearson Education
3. James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press
4. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
5. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage Hughes, Newnes Publisher.

References:

1. Millman and Halkies, "Integrated Electronics", Tata McGraw Hill.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.
3. Muhammad H. Rashid, "Power Electronics - circuits, devices and applications", Prentice Hall of India, 2nd edition.
4. P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.

Online References:

NPTEL courses on microelectronics: Devices to circuits



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		L	T	P	L	T	P	SL	Notional Learning Hour	
13211403	Discrete Structures and Automata Theory	3	–	--	45	–	--	45	90	3

Course Code		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
13211403	Discrete Structures and Automata Theory	20	20	40	60	2.5	--	--	100

Rationale :

Discrete Structures and Automata Theory are fundamental subjects in computer science that provide the mathematical and theoretical foundation for understanding computation and algorithms. Discrete structures, like sets, relations, and logic, form the basis for representing data and building algorithms, while automata theory studies abstract models of computation that are essential for designing and analyzing compilers, programming languages, and other computational systems.



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Course Objectives:

1. To cultivate clear thinking for Creative Problem Solving.
2. To train students to understand and construct Mathematical Proofs.
3. To introduce the notions of Sets, Relations, Functions, Graphs and their applications.
4. To build concepts of theoretical design of Basic machines, Deterministic and Non Deterministic Finite state machines and Pushdown Machines.
5. To gain the conceptual understanding of fundamentals of Grammars.
6. To prepare students with the mathematical aspects in other courses such as Formal Specification, Verification, Artificial Intelligence etc.

Course Outcomes:

1. Understand the notion of mathematical thinking, mathematical proofs and to apply them in problem solving.
2. To Reason Logically.
3. Perform operations with Sets, Relations, Functions, Graphs and their applications.
4. Design Deterministic Finite Automata (DFA) and Non-deterministic Finite Automata (NFA) and Pushdown Automata with understanding of power and limitations.
5. Design Context Free Grammar and perform the operations like simplification and normal forms.
6. Apply Discrete Structures and Automata Theory concepts into solving real world computing problems in the domain of Formal Specification, Verification, Artificial Intelligence etc.

Prerequisite: Basics of graphs, including their representation, properties, and common algorithms, Algebraic Structures, Logic and Proofs

DETAILED SYLLABUS:



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basics of graphs, including their representation, properties, and common algorithms, Algebraic Structures, Logic and Proofs		
I	Set Theory and Logic	Set Theory: Fundamentals - Sets and Subsets, Venn Diagrams, Operations on sets, Laws of Set Theory, Power Set, Principle of Inclusion and Exclusion, Mathematical Induction. Propositions and Logical operations, Truth tables, Equivalence, Implications Laws of Logic, Normal Forms, Inference Predicates and Quantifiers	7	CO1
		Self-learning Topics: Venn Diagrams, Set Theory	7	
II	Relations and Functions	Relations- Definition, Properties of Relations Types of binary relations (Equivalence and partial ordered relations), Closures, Poset, Hasse diagram and Lattice Functions- Definition, Types of Functions (Injective, Surjective and Bijective) Identity and Inverse Functions Pigeonhole Principle, Extended Pigeonhole Principle	8	CO2
		Self-learning Topics: Discrete Probability	8	
III	Graph Theory	Graphs and their basic properties - degree, path, cycle, subgraphs, Types of graphs. Definitions, Paths and circuits: Eulerian and	7	CO3



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		Hamiltonian, Planner Graph, Dijkstra Shortest Path Algorithm Trees, Types of Trees		
		Self-learning Topics: Isomorphism of graphs, Shortest Path Algorithms	7	
IV	Finite Automata	Introduction of Automata and its applications Deterministic Finite Automata (DFA) and Nondeterministic Finite Automata (NFA): Definitions, transition diagrams and Language recognizers, NFA to DFA Conversion. Eliminating epsilon-transitions from NFA. FSM with output: Moore and Mealy machines.	7	CO4
		Self-learning Topics: Automata and its applications	7	
V	Regular Expression (RE) and Regular Grammar (RG)	Regular Grammar and Regular Expression (RE): Definition, Equivalence and Conversion from RE to RG and RG to RE. Equivalence of RE and FA, Converting RE to FA and FA to RE.	8	CO5
		Self-learning Topics: Regular Expression	8	
VI	Context Free Grammar (CFG) and Push Down Automata (PDA)	Grammars: Chomsky hierarchy, CFG- Definition, Sentential forms, Leftmost and Rightmost derivations. Context Free languages (CFL): Parsing and Ambiguity. CFLs: Simplification and Applications. Normal Forms: Chomsky Normal Form, PDA-	8	CO6



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		Definition, Transitions (Diagrams, Functions and Tables), Design of PDA with Graphical Notation and Instantaneous Descriptions.		
		Self-learning Topics: Applications of PDA	8	
	Total		90	

Text Books:

1. Bernad Kolman, Robert Busby, Sharon Cutler Ross, Nadeem-ur-Rehman, "Discrete Mathematical Structures", Pearson Education.
2. C.L.Liu, "Elements of Discrete Mathematics", Second edition 1985, McGraw-Hill Book Company, Reprinted 2000.
3. John E. Hopcroft, Rajeev Motwani, Jeffery D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education.
4. Vivek Kulkarni, "Theory of Computation", Oxford University Press, India.

References:

1. K.H.Rosen, "Discrete Mathematics and applications", fifth edition 2003, Tata McGraw Hill publishing Company.
2. Y N Singh, "Discrete Mathematical Structures", Wiley-India.
3. J .L.Mott, A.Kandel, T.P .Baker, Discrete Mathematics for Computer Scientists and Mathematicians, second edition 1986, Prentice Hall of India.
4. J. P. Trembley, R. Manohar "Discrete Mathematical Structures with Applications to Computer Science", Tata Mcgraw-Hill.
5. Seymour Lipschutz, Marc Lars Lipson, "Discrete Mathematics" Schaum's Outline, McGraw Hill Education.
6. Daniel I. A. Cohen, "Introduction to Computer Theory", Wiley Publication.



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Michael Sipser, "Theory of Computation", Cengage learning.

7. J. C. Martin, "Introduction to Languages and the Theory of Computation", Tata McGraw Hill.

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs49/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105192/
3.	https://archive.nptel.ac.in/courses/106/103/106103070/



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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	
13212404	Analog Electronics Lab	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-1	IAT-2	Total				
13212404	Analog Electronics Lab	--	--	--	--	25	25	50

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Lab Objectives:

Lab course aims to

1. To design and analyze the frequency response of single-stage and Cascode MOSFET amplifiers, and evaluate their performance across low and high frequencies.
2. To determine the input and output impedance of a common source (CS) amplifier, both with and without feedback, and study its impact on amplifier behavior.
3. To study various configurations of operational amplifiers (inverting, non-inverting, differential, and instrumentation amplifiers) and measure their voltage gain.
4. To investigate oscillator circuits (Wien Bridge and RC Phase Shift) using op-amps, and calculate the frequency of oscillations theoretically and experimentally.
5. To implement and analyze op-amp applications such as summing amplifier, comparator, zero-crossing detector, and Schmitt trigger, including threshold voltage measurements.
6. To study the operation of IC 555 timer in astable mode and verify timing parameters such as frequency and duty cycle through practical implementation.

Lab Outcomes:

After the successful completion students should be able to

1. Analyze and interpret the frequency response of single-stage and Cascode MOSFET amplifiers, identifying bandwidth, gain, and the effect of cascading stages.
2. Measure and compare the input and output impedance of a CS amplifier, and evaluate the role of feedback in modifying impedance characteristics.
3. Demonstrate the ability to configure and operate op-amps in inverting, non-inverting, differential, and instrumentation amplifier modes with accurate gain calculation.
4. Calculate the frequency of oscillation in Wien bridge and RC phase shift oscillators and validate it through experimental results.

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5. Implement and test op-amp-based analog circuits including summing amplifier, comparator, zero-crossing detector, and Schmitt trigger, and determine key parameters like threshold voltages.
6. Design and analyze an astable multivibrator using IC 555 timer, accurately computing and verifying the frequency and duty cycle of the output waveform.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	Electronic Devices Lab		
1	To implement single stage MOSFET CS amplifier and study its frequency response	2	LO1
2	To implement a CS-CG MOSFET Cascode amplifier and study its frequency response.	2	LO1
3	To determine input and output impedance of a CS amplifier with and without feedback.	2	LO2
4	To measure parameters of Op-amp.	2	LO3
5	Study of IC 741 Op-Amp – Pin Diagram and Functional Description	2	LO3
6	To study Inverting and Non-inverting configuration of Op-amp.	2	LO3
7	To study Op-amp as a differential amplifier.	2	LO3
8	To study and calculate frequency of oscillations of Wien bridge oscillator	2	LO4
9	To study and calculate frequency of oscillations of RC Phase shift oscillator	2	LO4



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10	To study voltage gain of three Op-amp instrumentation amplifier	2	LO5
11	To study the operational amplifier as a summing amplifier.	2	LO5
12	To determine upper and lower threshold voltage in Schmitt trigger using IC 741.	2	LO5
13	Study of inverting and Non-inverting comparator using Op-amp	2	LO5
14	To study and implement an Astable multi-vibrator using a 555 timer IC.	2	LO6
15	To study Op-amp as comparator and zero crossing detector	2	LO6

Text Books:

1. David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.
2. Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", 2nd edition, PHI, 1995
3. Mithal. G.K, "Practicals in Basic Electronics", G K Publishers Private Limited, 1997.
4. Sergio Franco, "Design with operational amplifiers & analog integrated circuits", Tata McGraw Hill, 3rd edition
5. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson Prentice Hall, 4th Edition.

Online Resources:

Sr. No.	Website Name
1.	https://www.allaboutcircuits.com/
2.	https://www.tinkercad.com/
3.	https://www.circuitlab.com/



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Laboratory Assessment:

Assessment:

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

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

Practical/ Oral Exam: An Oral and practical examination 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	
13212405	IDEA LAB - IV (Innovation Design Engineering and Apply)	1	--	2*	15	--	30	15	60	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13212405	IDEA LAB – IV (Innovation Design Engineering and Apply)	--	--	--	--	50	50	100



Rationale :

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

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

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

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

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

Lab Objectives:

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



Lab Outcomes: Student will be able to

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

1) Guidelines for IDEA Project

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

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



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

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

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

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

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



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

b) Implementation of Subject-Term Work Mapping within Projects

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

Implementation Notes:

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

2) Guidelines for Assessment

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

**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:



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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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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	
13412406	Skill base Lab - Java	-	-	2	-	-	30	-	30	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
13412406	Skill base Lab- Java	--	--	--	--	25	25	50

Lab Objectives:**Lab course aims to**

1. To understand Object Oriented Programming basics and its features.
2. To understand and apply Object Oriented Programming (OOP) principles using C++
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
4. Able to use a programming language to resolve problems.

*R-2025- S.E (Sem- IV) Electronics and Computer Science***Lab Outcomes:****After the successful completion students should be able to**

1. Use different control structures.
2. Understand fundamental features of an object-oriented language: object classes and interfaces, exceptions and
3. Understand the fundamentals of libraries of object collections.
4. Understand Java Programming.
5. To develop a program that efficiently implements the features and packaging concept of java in the laboratory.
6. To implement Exception Handling and Applets using Java.

DETAILED SYLLABUS

Sr. No.	List of Experiments	Hours	LO Mapping
Prerequisite	• Fundamentals of C-Programming • Control Structures • Arrays and String		
1	Display addition of number	2	LO1
2	Accept marks from user, if Marks greater than 40, declare the student as "Pass" else "Fail"	2	LO1
3	Accept 3 numbers from the user. Compare them and declare the largest number (Using if-else statement).	2	LO2
4	Display sum of first 10 even numbers using do-while loop.	2	LO3
5	Display Multiplication table of 15 using a while loop.	2	LO3
6	Display Multiplication table of 15 using a while loop.	2	LO3
7	Display the sum of elements of arrays.	2	LO4



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8	Accept and display the string entered and execute at least 5 different string functions on it.	2	LO4
9	Read and display the numbers as command line Arguments and display the addition of them	2	LO5
10	Define a class, describe its constructor, overload the Constructors and instantiate its object	2	LO6
11	Illustrate method of overloading	2	LO6
12	Demonstrate Parameterized Constructor	2	LO6
13	Implement Multiple Inheritance using interface	2	LO6
14	Create thread by implementing 'Runnable' interface or creating 'Thread Class.	2	LO6
14	Demonstrate Hello World Applet Example	2	LO6
15	Write a Java program for handling mouse events	2	LO6

Online Resources:

Sr. No.	Website Name
1.	J-Edit/J-Editor/Blue J
2.	CodeBlock: http://www.codeblocks.org/
3.	Netbeans: https://netbeans.org/downloads/
4.	Eclipse: https://eclipse.org/
5.	Raptor-Flowchart Simulation: http://raptor.martincarlisle.com/



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Laboratory Assessment:

Assessment:

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

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

Practical/ Oral Exam: An Oral and practical examination will be held based on the above syllabus.

Recommended Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, 10th Edition, 2017.
2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI, 2009.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Languageser Guide", Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010

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

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	
9951149 WW	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	Total .					
9951149 WW	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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R-2025- S.E (Sem IV) All Branches

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned					Total Credits (C) (Notional Learning Hour/30)
		L	T	P	L	T	P	SL	Notional Learning Hour	
98451410	Design Thinking	2	-	-	30		-	30	60	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
98451410	Design Thinking	20	20	40	60	2.5	--	--	100

Rationale:

Design Thinking is a human-centered approach that fosters creativity, empathy, and problem-solving. This course equips students with tools to understand user needs, generate innovative ideas, and develop practical solutions for real-world challenges.

Course Objectives:

1. Introduce the core principles and stages of the Design Thinking process.
2. Develop an empathetic mindset to understand user needs.

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3. Frame clear problem statements using user-centered tools.
4. Apply ideation techniques to generate creative solutions.
5. Understand various types of prototypes and their role in product development.
6. Learn the process of testing and refining ideas based on feedback.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Compare traditional and design thinking-based approaches to problem solving.
2. Define user personas using empathy and mapping techniques.
3. Frame actionable problem statements using POV and problem definition tools.
4. Apply ideation techniques to develop diverse solution sets.
5. Differentiate between low and high-fidelity prototypes and understand their usage.
6. Explain how to test prototypes based on desirability, feasibility, and usability.

Prerequisite: Fundamentals of communication and leadership skills.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Fundamentals of communication and leadership skills		
I	Introduction to Design Thinking	Introduction to Design Thinking: Definition, Comparison of Design Thinking and traditional problem-solving approach, Need for Design Thinking approach, Key tenets of Design Thinking, 5 stages of Design Thinking (Empathize, Define, Ideate, Prototype, Test)	4	CO1
		Self-learning Topics: Design thinking case studies from various domains.	4	



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

		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, Breaking patterns, Challenging assumptions, Looking across value chain, Looking beyond recommendation, Techniques for ideation: Brainstorming, Mind	6	CO4



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

		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	

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

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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



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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	Total					
98431411	Business Model Development	--	--	--	--	--	25	--	25

Rationale

Entrepreneurship is the backbone of innovation and economic growth. In the 21st-century knowledge economy, students must be equipped not just with employment-ready skills but with a problem-solving and innovation mindset to become job creators. This course blends core entrepreneurship principles with business model design, startup financing, and digital business strategies.

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Course Objectives:

1. To introduce students to entrepreneurship and its socio-economic relevance.
2. To enable understanding of different business structures and MSME significance.
3. To familiarize learners with funding mechanisms for startups.
4. To introduce the basics of IPR and ethical innovation practices.
5. To equip students with tools for building business models and MVPs.
6. To explore digital marketing and disruption in online business ecosystems.

Course Outcomes:

On successful completion of the course learner will be able to:

1. Define and explain entrepreneurship and its key types.
2. Analyze the legal and operational structure of business ownership.
3. Identify and compare startup funding models and sources.
4. Apply the fundamentals of IPR to protect entrepreneurial innovations.
5. Create comprehensive business models using BMC tools.
6. Evaluate and apply digital marketing techniques for online business models.

Prerequisite: Basic Design Thinking principles.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Basic Design Thinking principles		
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	5	



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		https://www.thehenryford.org/docs/default-source/default-document-library/default-document-library/henryfordandinnovation.pdf?sfvrsn=0 The Tatas: How a Family Built a Business and a Nation by Girish Kuber, April 2019, Harper Business		
II	Entrepreneurship Development	Types of business ownerships: Proprietorship, Public and Private Companies, Co-operative businesses, Micro, Small and Medium Enterprises (MSME): Definition and role of MSMEs in economic development.	4	CO2
		Self-learning Topics: MSME Act and Udyam Registration portal Case Study: Amul – Co-operative innovation in dairy sector	4	
III	Start-up financing	Start-up financing: Cost and revenue models, Sources of start-up fundings: Angel investors, Venture capitalists, Crowd funding, Government schemes funding(e.g., SIDBI, Startup India).	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



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		Self-learning Topics: Case Study: WIPO Patent Search Exercise	5	
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:

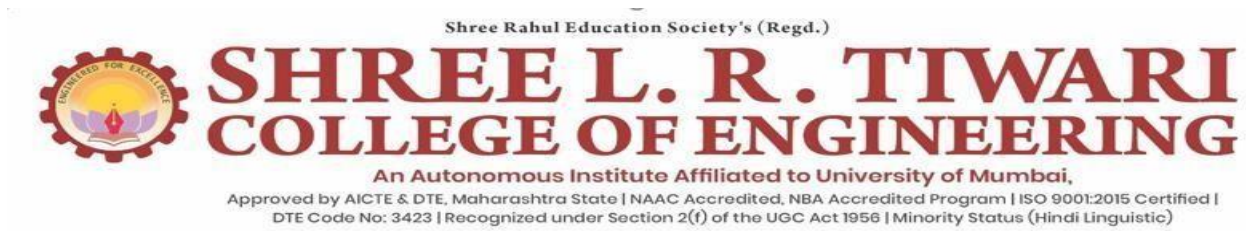
1. Entrepreneurship: David A. Kirby, McGraw Hill, 2002
2. Harvard Business Review: Entrepreneurs Handbook, HBR Press, 2018
3. Business Model Generation; Alexander Ostlewalder and Yves Pigneur, Strategyzer, 2010
4. E- Business & E- Commerce Management: Strategy, Implementation, Practice – Dave Chaffey, 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.prismatic.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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R-2025- T.E (Sem-V) Electronics and Computer

SEM V



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R-2025- T.E.(SEM V)Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC501	Communication Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC501	Communication Engineering	20	20	40	60	2.5	--	--	100

Rationale :

Communication Engineering, also known as Electronics and Communication Engineering, focuses on the transmission and reception of information across various mediums, including digital and analog signals. It involves designing and developing systems for sending and receiving signals, often using electrical or electroacoustic devices and electromagnetic waves. ECS engineers work with hardware, software, and networks to create and maintain communication infrastructure.



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R-2025- T.E.(SEM V)Electronics and Computer Science

Course Objectives:

1. To understand and analyse the need for various analog modulation techniques
2. To analyse the characteristics of the receivers
3. To understand pulse modulation methods
4. To understand the effect of ISI in Baseband transmission of a digital signal
5. To analyse various Digital modulation techniques

Course Outcomes:

1. Analyse various analog modulation methods.
2. Compare various analog Demodulation methods.
3. Explain various pulse modulation techniques.
4. Evaluate the impact of Inter Symbol Interference in Baseband transmission and methods to mitigate its effect.
5. Compare various Digital modulation methods based on spectral efficiency, Euclidean distance etc
6. Analyse the characteristics of radio receivers.

Prerequisite: Engineering Mathematics - IV

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Electronic Communication	Electromagnetic Spectrum, Block diagram of Analog communication system ,Need for modulation. Types of Noise, Signal-to-noise ratio, Noise factor, Noise Figure, Noise Temperature	07	CO1
II	Analog Modulation Systems	Principle of Amplitude Modulation (AM): Representation of AM wave (Mathematical & Graphical), Frequency spectrum of AM wave, AM Power Distribution, AM for a Complex Modulating Signal. Types of AM: Generation of DSB-SC using diode based balanced modulator, Generation of SSB using phase shift method, Principles of Angle Modulation: Theory of Frequency Modulation (FM) & Phase Modulation (PM) - Basic Concepts, Spectrum Analysis of FM Wave, Noise triangle, Pre-emphasis, De-emphasis. Comparison of AM, FM and PM	06	CO2
III	Radio Transmitters and	Radio Transmitters: Block diagram of AM & FM transmitters, Radio receivers: Receiver Characteristics, Superheterodyne Receiver,	06	CO3

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	Receivers	diode detector, Automatic gain control (AGC), Automatic frequency control (AFC).		
IV	Pulse Modulation	Sampling theorem and quantization of signals Generation and Detection of Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), and Delta Modulation (DM), Multiplexing Techniques: Time Division Multiplexing (TDM):T1 carrier system, Frequency Division Multiplexing (FDM)	08	CO4
V	Pulse Shaping for Optimum Transmission	Line codes and their desirable properties, PSD of digital data Concept of Inter symbol interference (ISI), Eye diagram: Quality Factor and BER, Nyquist Bandwidth Types of equalizers: Linear equalizer. Correlative coding: Duo-binary encoding and modified duo-binary encoding.	06	CO5
VI	Digital Modulation Techniques	Bandpass digital transmitter and receiver model. Generation, detection, signal space diagram, power spectral density and spectrum efficiency analysis of: Binary Phase Shift Keying (BPSK), Quaternary Phase Shift Keying (QPSK), M-ary PSK, Binary Amplitude Shift Keying (BASK), Quadrature Amplitude Modulation (QAM), Binary Frequency Shift Keying (BFSK), Minimum Shift Keying (MSK).	06	CO6
Total			39	

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Text Books:

1. Simon Haykin, “Communication System”, John Wiley And Sons ,4th Ed
Taub Schilling & Saha, “Principles Of Communication Systems”, Tata Mc-Graw Hill, Third Ed
2. Kennedy and Davis “Electronics Communication System”, Tata McGraw Hill
3. T. L. Singal, “Analog and Digital Communication,” Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
4. Sklar B, and Ray P. K., “Digital Communication: Fundamentals and Applications,” Pearson, Dorling Kindersley (India), Delhi, Second Edition, 2009.

Reference Books:

1. Bernad Sklar,- “Digital communication”, Pearson Education, 2nd Ed.
2. Simon Haykin, “Digital communication”, John Wiley and sons
3. Wayne Tomasi, “Electronics Communication Systems” Pearson Education, Third Edition, 2001.
4. R P Singh &S. Sapre, “Analog and Digital Communication”, Tata McGraw Hill 2nd Ed.
5. Proakis & Salehi, “Communication System Engineering”, Pearson



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Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117102059
2.	https://archive.nptel.ac.in/courses/117/105/117105144/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ECC502	Computer Organization and Architecture	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC502	Computer Organization and Architecture	20	20	40	60	2.5	--	--	100

Rationale:

Computer Organization and Architecture (COA) provides essential knowledge of how computer systems function at the hardware level. It covers topics like CPU design, memory systems, instruction execution, and input/output mechanisms. For Electronics and Computer Science Engineering students, COA bridges hardware and software, enabling a deeper understanding of system performance, embedded systems, and

low-level programming. This foundation is crucial for advanced studies and careers in system design, hardware development, and software optimization.

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Course Objectives:

1. To introduce the learner to the design aspects which can lead to maximized performance of a Computer.
2. To introduce basic concepts and functions of processors with respect to performance.
3. To understand the concepts of various Memory, I/O and File management techniques.
4. To understand the concepts of process management of an operating system & various process scheduling algorithms.
5. To introduce the learner to various concepts related to Parallel Processing
6. To highlight the various architectural enhancements in modern processors.

Course Outcomes:

1. Define the performance metrics of a computer system, including throughput, latency, and efficiency. (Define)
2. Explain design considerations of processor, memory, and I/O subsystems with respect to performance, scalability, and integration. (Explain)
3. Interpret the objectives and core functions of an operating system, including process, memory, and file management. (Interpret)
4. Analyze the concept of process management of an operating system and Evaluate the performance of various process scheduling algorithms based on turnaround time, waiting time, and CPU utilization. (Analyze/Evaluate)
5. Evaluate the advantages and limitations of parallelism in computer systems and Assess trade-offs in performance, cost, and complexity. (Evaluate/Assess)
6. Discuss architectural enhancements in modern processors, such as pipelining, superscalar execution, and speculative execution, and Compare their impacts on system performance. (Discuss/Compare)

Prerequisite:

1. Digital Electronics
2. Fundamental concepts of processing
3. Data structures

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Computer Organisation	Fundamental Units of a Computer, Basic Measures of Computer Performance - Clock Speed, CPI, MIPS and MFlops Number Representation methods- Integer and Floating-point	2	CO1
II	Processor Organization and Architecture	CPU Architecture, Register Organization, Instruction cycle, Instruction Formats. Control Unit Design- Hardwired and Micro-programmed Control: Vertical and Horizontal MicroInstructions, Nano-programming Comparison between CISC and RISC architectures.	5	CO2
III	Memory and I/O Organization	Classification of Memories-Primary and Secondary Memories, ROM and RAM, Memory Inter- leaving. Memory Hierarchy, Cache Memory Concepts, Mapping Techniques, Write Policies, Cache Coherency. Virtual Memory Management-Concept, Segmentation, Paging, Page Replacement policies.	9	CO3

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		Types of I/O devices and Access methods, Types of Buses, Bus Arbitration.		
IV	Operating System concepts	Concept of a Process, Process States, Process Description, Process Control Block. Process scheduling -Pre-emptive and Non pre-emptive scheduling algorithms (FCFS, Priority, SJF), Concept of Multi-Threading. Inter-Process Communication, Process Synchronization, Deadlock and Prevention File Management -File Organization and Access I/O Management and Disk Scheduling: FCFS, SSTF.	15	CO4
V	Parallelism	Introduction to Parallel Processing Concepts, Flynn's classification, Amdahl's law Pipelining - Concept, Speedup, Efficiency, Throughput, Types of Pipeline hazards and solutions	4	CO5
VI	Architectural Enhancements	Superscalar Architectures, Out-of-Order Execution, Multi-core processors, Clusters, GPU	4	CO6
Total			39	

Text Books:

1. William Stallings, "Computer Organization and Architecture: Designing for Performance", Eighth Edition, Pearson.
2. C. Hamacher, Z. Vranesic and S. Zaky, "Computer Organization", McGraw Hill, 2002.

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3. William Stallings, Operating System: Internals and Design Principles, Prentice Hall, 8th Edition
4. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, John Wiley & Sons, Inc., 9th Edition,

References:

1. P. Hayes, "Computer Architecture and Organization", McGraw-Hill, 1998.
2. B. Govindarajulu, "Computer Architecture and Organization: Design Principles and Applications", Second Edition, Tata McGraw-Hill.
3. D. A. Patterson and J. L. Hennessy, "Computer Organization and Design - The Hardware/Software Interface", Morgan Kaufmann, 1998.
4. Achyut Godbole and Atul Kahate, Operating Systems, McGraw Hill Education, 3rd Edition
5. Andrew Tannenbaum, Operating System Design and Implementation, Pearson, 3rd Edition

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs88/preview
2.	http://ndl.iitkgp.ac.in/he_document/icar_nahep/icar_elearning/P_C_C_O_A_A_305_96341?e=1 computer%20organization%20and%20architecture



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theor y	Pract	Tut.	Theory	Pract.	Tut.	Total
ECC503	Software Engineering	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC503	Software Engineering	20	20	40	60	2.5	--	--	100

Rationale :

Software Engineering provides a structured approach to software development, covering key areas like requirements, design, testing, and project management. It helps students build reliable, maintainable, and scalable software systems using industry-standard practices. This subject prepares students to handle real-world projects efficiently, promoting quality, collaboration, and innovation in software development.

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Course Objectives:

1. To learn the basics of software engineering and software development process models, agile software development and other agile practices.
2. To Identify, Specify, analyze Software Requirements and prepare model.
3. To understand concepts and principles of software design and Development.
4. To learn about Project Scheduling concept and Software Cost Estimation Techniques.
5. To understand the concept of software quality assurance and Risk Management.
6. To learn different software testing strategies and tactics

Course Outcomes:

1. Apply software engineering concepts and choose process models for software project development.
2. Analyze and specify software requirement specification (SRS) for software system.
3. Convert requirement model into the design model and demonstrate the use of software and user interface design principles.
4. Generate the project schedule and estimate the cost of the software system.
5. Identify risks and prepare RMMM plans for quality software systems.
6. Apply testing strategies and tactics for software systems.

Prerequisite:

- 1) Knowledge of Software Application Domains, Software Engineering Practices.
- 2) Knowledge of any Programming Language.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to Software Engineering and Process Models	Nature of Software, Software Process framework. Prescriptive Models: Waterfall Model, Incremental, RAD Models Evolutionary Process Models: Prototyping, Spiral and Concurrent Development Model. Specialized Models: Component based Agile process, Agility Principles, Extreme Programming (XP), Scrum.	7	CO1
II	Requirement Engineering and Modelling	Types of Requirements, Requirement Engineering Task, Software Requirement Specification (SRS), Developing Use Cases (UML). Requirement Model: Scenario-based model, Class-based model, Behavioral model.	8	CO2
III	Design Engineering	Design Concepts, Design Principles. Architecture Design, Component Level Design, System Level Design, User Interface Design	6	CO3
IV	Project scheduling & Cost Estimation	Project Scheduling, defining a Task Set for the Software Project, Gantt charts, Program Evaluation Review Techniques (PERT), Tracking the Schedule. Software Project Estimation, Decomposition Techniques, LOC based, FP based and Use	6	CO4

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		case-based estimations, Empirical estimation Models. COCOMO II Model.		
V	Software Risk & Quality Management	Software Risk, Types of Risk, Risk Identification, Risk Assessment, Risk Projection, RMMM. Software Quality Assurance Task and Plan, McCall's Quality Factors, Software Reliability, Formal Technical Review (FTR), Walkthrough	6	CO5
VI	Software Testing Strategies and Tactics	Software Testing Fundamentals, Testing strategies for conventional and Object Oriented architectures, Unit testing, Integration testing, System Testing, Validation and System Testing. Testing Tactics: White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.	6	CO6
	Total		39	

Text Books:

1. Roger S Pressman "Software Engineering: A Practitioner's Approach" 8th Edition McGraw- Hill, ISBN:978-0-07-802212-8
2. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Narosa

References:

1. Ian Sommerville, "Software Engineering", Pearson Education (9th edition)
2. Jibitesh Mishra and Ashok Mohanty, "Software Engineering", Pearson edition
3. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India
4. Hans Van Vilet, "Software Engineering Principles and Practice" 3rd edition Wiley



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Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc20_cs68/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105182/
3.	https://nptel.ac.in/courses/106105182

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC504	Web Technologies	03	-	-	03	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC504	Web Technologies	20	20	40	60	2.5	--	--	100

Rationale:

Web technologies provide the tools and infrastructure to create, deploy, and manage websites and web applications, enabling communication and information sharing across the internet. They encompass a wide range of aspects, including web design, development, servers, browsers, and e-commerce platforms.



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Course Objectives:

1. Understand core web development technologies including HTML, CSS, JavaScript, and server-side scripting.
2. Integrate AI services or models to create dynamic and context-aware user experiences.
3. Apply principles of responsive and accessible design.
4. Utilize real-time data, APIs, and user inputs for personalization.
5. Align technical development with social responsibility goals such as water conservation.

Course Outcomes:

- 1) **Design** static web pages using HTML5. (*Design*).
- 2) **Design** responsive front-end interfaces for public awareness. (*Design*).
- 3) **Develop** client side validation and scripts to static web pages (*Develop*).
- 4) **Deploy** and test a functional website using industry-standard tools and hosting using Bootstrap. (*Deploy/Test*).
- 5) **Construct** dynamic web pages using server side scripting (*Creating*).
- 6) **Develop** a web application using appropriate web development framework (*Develop*).

Prerequisite: Basics of programming languages, Basic knowledge of HTML.



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DETAILED SYLLABUS:

Sr. No	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to HTML5	Basic structure of an HTML5 document, Creating an HTML5 document, Markup Tags, Heading-Paragraphs, line Breaks HTML5 Tags - Introduction to elements of HTML, Working with Text, Lists, Tables and Frames, Hyperlinks, Images and Multimedia, Forms and other HTML5 controls. Self-Learning: HTML5 based game development.	4	CO1
II	Static Web Page Design	Concept of CSS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), Working with block elements and objects, Lists and Tables, CSS Id and Class, Box Model(Introduction, Border properties, Padding Properties, Margin properties). CSS Advanced: (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector). Self-Learning: Creating page Layout and Site Designs.	4	CO2
III	Client-side scripting	JavaScript:Introduction to JavaScript, Lexical Structure, Types, Values, Variables, Expressions and Operators, Statements, Objects, Arrays, Functions, Pattern matching	6	CO3



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		with regular expressions, JavaScript in Web Browsers, The Window object, Scripting Documents, Scripting CSS, Handling Events. jQuery: jQuery Basics, jQuery Getters and Setters, Altering Document Structure, Handling events with jQuery, Animated Effects, Utility functions, jQuery Selectors and Selection Methods, Extending jQuery with Plug-ins, The jQuery UI Library Self-Learning: JavaScript Framework – AngularJS.	4	
IV	Bootstrap	Introduction to Bootstrap, downloading and installing Bootstrap. The Grid System: Introducing the Grid, Offsetting and Nesting, ResponsiveFeatures, Utility Classes, and Supported Devices.CSS Foundations: Typography in Bootstrap, Styling Tables, Styling Forms,Styling Buttons, Images, icons, and Thumbnails.Navigation Systems: Tabs, Pills, and Lists, Breadcrumbs and Pagination,Navigation Bar, Making the Navigation Bar Responsive.JavaScript Effects: Drop-downs, Modal Windows, Tooltips and Popovers,Navigation Aids: Tabs, Collapse, Affix, Carousel. Self-Learning:Bootstrap,Customization: Combining Elements in Bootstrap, Customizing by Components, Plugins, and Variables.	6	CO4



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V	Server side-scripting:	Introduction to PHP, PHP Tags. Adding Dynamic content, Accessing form variables, Identifiers, user-declared variables, Data types, Constants, Operators, Control structures, Conditionals, Iteration constructs, Using arrays, string manipulation and regular expressions, reusing code and writing functions, Designing and creating your web database, Accessing MySQL database from the Web with PHP, Session Control in PHP. Self-Learning: PHP-NoSQL Database connectivity e.g. PHP-MongoDB connectivity	10	CO5
VI	Web Development Framework	MVC architecture - Introduction and applications Server side-scripting – Laravel Framework Managing Your Project Controllers, Layout, Views, and Other Assets, Talking to the Database, Model Relations, Scopes, and Other Advanced Features, Integrating Web Forms, Authenticating and Managing Your Users, Deploying, Optimizing and Maintaining Your Application Self-learning: Django Framework, Interactive web sites, web-based information system, blogs, social networking sites,	5	CO6
	Total		39	



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Text Books:

1. Ralph Moseley, M.T. Savliya , “Developing Web Applications”, Willy India, Second Edition,
2. “Web Technology Black Book”, Dreamtech Press, First Edition, 978-7722-997.
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition, O'REILLY, 2014. (http://www.ebooksbucket.com/uploads/itprogramming/javascript/Le_arning_PHP_MySQL_Javascript_CSS_HTML5_Robin_Nixon_3e.pdf).
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications. <https://ebooks-it.org/0470082801-ebook.htm>.
5. Jennifer Kyrnin, “SAMS Teach Yourself Bootstrap in 24 hours”, 1st edition, Pearson Education.
6. Martin Bean, “Laravel 5 Essentials”, PACKT Publishing Ltd.

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 Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
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.
7. J. Millman and A. Grabel, “Head First HTML and CSS”, 2nd edition, O'Reilly.



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8. Ben Frain, “Responsive Web design with HTML5 and CSS3”,
PACKT Publishing Ltd.
9. L. Welling and L. Thomson, “PHP and MySQL Web Development”, 4th
edition, Adison Wesley Professional.

Online References:

Sr. No.	Website Name
1.	www.nptelvideos.in
2.	www.w3schools.com
3.	http://spoken-tutorial.org



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC55 1	Software Testing & Quality Assurance	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC551	Software Testing & Quality Assurance	20	20	40	60	2.5	--	--	100

Rationale :

In the software development lifecycle, ensuring the reliability, functionality, and performance of software systems is critical. The subject STQA equips students with fundamental and advanced concepts of software testing methodologies, techniques, and tools. It fosters a deep understanding of how to design effective test cases, conduct automated and manual testing, and apply quality assurance practices throughout the development process. By mastering STQA, learners become capable of delivering

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high-quality software that meets user requirements and industry standards, ultimately contributing to cost-effective, error-free, and maintainable software solutions.

Course Objectives:

1. To provide students with knowledge in Software Testing techniques.
2. To provide knowledge of Black Box and White Box testing techniques.
3. To provide skills to design test case plans for testing software.
4. To prepare test plans and schedules for testing projects.
5. To understand how testing methods can be used in a specialized environment.
6. To understand how testing methods can be used as an effective tool in providing quality assurance concerning software.

Course Outcomes:

After successful completion of the course students will be able to:

1. Investigate the reason for bugs and analyze the principles in software testing to prevent and remove bugs.
2. Understand various software testing methods and strategies.
3. Design test planning.
4. Manage the test process.
5. Apply the software testing techniques in the commercial environment.
6. Use practical knowledge of a variety of ways to test software and quality attributes

Prerequisite: Programming Language (C++, Java), Software Engineering



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Testing Methodology	Introduction to Software Testing: Introduction, Goals of Software Testing, Software Testing. Definitions, Model for Software Testing, Effective Software Testing vs Exhaustive Software Testing, Software Failure Case Studies. Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology Verification and Validation: Verification, Verification requirements, Validation.	07	CO1
II	Testing Techniques	Black Box testing: boundary value analysis, equivalence class testing, state table-based testing, cause-effect graphing based testing, error guessing. White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing, Static Testing. Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing.	09	CO2



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		Regression Testing: Progressive vs. Regressive		
III	Managing the Test Process	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification. Software Metrics: need, definition and classification of software matrices. Efficient Test Suite Management: minimizing the test suite and its benefits.	08	CO3
IV	Test Automation	Automation and Testing Tools: need, categorization, selection and cost in testing tool, Guidelines for testing tools.	05	CO4
V	Testing for Specialized Environment	Agile Testing, Agile Testing Life Cycle, Challenges in Agile Testing. Testing Object-Oriented Software: OOT Basics, Object-oriented Testing.	04	CO5
VI	Quality Management	Software Quality Management, McCall's quality factors and Criteria ISO9000:2000, SIX Sigma Self-learning Topics: Case Studies to Identify Quality Attributed Relationships for different types of Applications (Web based, Mobile based etc.)	04	CO6

Text Books:

1. Software Testing Principles and Practices Naresh Chauhan Oxford Higher



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Education

2. Software Testing and quality assurance theory and practice by Kshirasagar Naik, Priyadarshi Tripathy , Wiley Publication

References:

1. Effective Methods for Software Testing , third edition by Willam E. Perry, Wiley Publication.
2. Software Testing Concepts and Tools by Nageswara Rao Pusuluri , Dreamtech press

Online References:

Sr. No.	Website Name
1	http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1099-1689
2	NPTEL https://onlinecourses.nptel.ac.in/noc17_cs32/preview

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ECC552	ASIC Verification	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Prac / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC552	ASIC Verification	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To introduce the learner System Verilog concepts for verification.
2. To provide understanding of System Verilog and SVA for verification, and understand the improvements in verification efficiency.
3. To introduce the learner advanced verification features such as practical use of classes, randomization, checking and coverage.

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4. To highlight the significance of verification in the VLSI industry.
5. To provide hands-on experience with industry tools (e.g., Synopsys VCS, Cadence Incisive, Mentor Questa) for simulation and debugging.
6. To enable students to analyze and improve the completeness of verification using metrics such as functional coverage and code coverage.

Course Outcomes:

In the end of this course, students will be able to:

1. Demonstrate understanding of the role of verification in the ASIC development lifecycle.
2. Develop verification environments for digital circuits using advanced features of SystemVerilog.
3. Construct modular, scalable verification environments using the Universal Verification Methodology.
4. Implement SystemVerilog Assertions (SVA) and collect coverage metrics for effective test planning.
5. Design and apply both constrained-random and directed input stimulus to uncover edge-case bugs.
6. Identify, isolate, and fix functional issues in RTL designs using waveform viewers and simulators.

Prerequisite: Digital Electronics (ECC 303), Microprocessors and Microcontrollers (ECC 404)



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Programmable Devices and Verification Basics	Programmable Devices: Different types of Integrated Circuits- CPLD, FPGA, ASIC, SoC (System-on-Chip), SiP (System-in-Package), MCM (Multi-Chip Module), SoP (System-on-Package), Choices based on application and cost, Architecture of FPGA, CPLD (Xilinx and Altera family devices) , Difference between ASIC, FPGA and CPLD, ASIC flow and overview of types of tools used in each stage of lifecycle Verification Basics: Introduction, Verification Process, Verification Plan, Verification Methodology options, Basic Testbench Functionality, Directed Testing, Constrained-Random Stimulus, Functional Coverage, Testbench Components, Layered Testbench, Technology challenges test, Verification languages, Verification IP reuse, Verification approaches.	7	CO1
II	Data types, Procedural statements, Connecting the	Data Types: Built-in Data Types, Logic Data type, Fixed-Size Arrays (Packed and Unpacked arrays), Dynamic Arrays, Queues, associative array, array methods –	8	CO2

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	Test bench and Design	Reduction, Locator & ordering, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings, Expression width. Procedural statements: Procedural Statements, Tasks, Functions, and Void Functions, routine arguments, returning from a routine, Time values. Connecting the Test bench and Design: Separating the test-bench and design, The Interface construct, Grouping Signals in an Interface using Modports, Creating Interface Monitor, Stimulus timing with Clocking Block, Test-bench design Race Condition, Program Block, Connecting it all together, Top level Scope, Program-Module interactions.		
III	Basic Object -Oriented Programming	OOP: Class, Creating new objects, Where to Define a Class, OOP Terminology, Understanding Dynamic objects, Object Deallocation, using objects, Static vs Global Variables, Class methods, Defining methods outside class, Scoping rules, Using one class inside another, Understanding Dynamic objects, Copying objects, public vs. local, Building a test-bench	06	CO3
IV	Randomization and Inter-process Communication	Randomization: Randomization in system Verilog, Constraint details, Solution probabilities, Controlling multiple constraint blocks, Valid constraints, In-line	7	CO4

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		constraints, The pre-randomize and post-randomize functions, Random number functions, Constraints tips and techniques. Threads and Inter-process Communication: Working with threads, disabling threads, inter-process communication, Events, Semaphores, Mailboxes, building a test-bench with threads and IPC.		
V	System Verilog Assertions and Functional Coverage	Assertions, Concurrent Assertions, SVA Property and Sequences, Implication(Overlapped & Non-Overlapped) Operator and Repetition Operator, System Verilog Assertion built-in methods (\$rose, \$fell, \$stable, \$past) Functional Coverage: Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, anatomy of a cover group, triggering a cover group, data sampling, cross coverage, generic cover groups, Coverage Options, Parameterized Cover Groups, Analysing Coverage Data, Measuring Coverage Statistics During Simulation.	7	CO5
VI	System Verilog Test-bench Case studies	A complete System Verilog Layered Test-Bench for the simple design of ADDER and Memory module- Test-Bench Architecture, Transaction Class, Generator	4	

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		Class, Interface, Driver Class, Monitor, Scoreboard, Environment, Test Bench Top		
	Total		39	

Text Books:

1. Chris Spear, "SystemVerilog for Verification: A guide to learning the testbench language features", Springer, 3rd Edition.
2. Janick Bergeron, "Writing Testbenches Using SystemVerilog", Springer 2006.
3. Stuart Sutherland, Simon Davidmann, and Peter Flake, "SystemVerilog for Design: A guide to using system verilog for hardware design and modeling", Springer, 2nd Edition.

Reference Books:

1. Ben Cohen, Srinivasan Venkataramanan, Ajeetha Kumari and Lisa Piper, "SystemVerilog Assertions Handbook", Vhdl Cohen Publishing, 3rd edition.
2. S Prakash Rashinkar, Peter Paterson and Leena Singh, "System on Chip Verification Methodologies and Techniques", Kluwer Academic, 1st Edition.
3. System Verilog Language Reference manual.
4. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis" second edition, Pearson – IEEE 1364-2001 compliant.
5. Spartan and Virtex family user manuals from Xilinx.
6. Verilog Language Reference manual.

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut	Theory	Pract	Tut.	Total
ECC553	Information Theory and Coding	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract/ Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC553	Information Theory and Coding	20	20	40	60	2.5	--	--	100

Rationale :

Information theory and coding are essential for modern communication and data processing, as they provide the tools for efficient and reliable transmission of information. They address fundamental questions about data compression, channel capacity, and error correction, enabling us to design efficient and robust communication systems.

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Course Objectives:

1. Learn the principles and applications of information theory in communication.
2. Study various codes used for data compression.
3. Learn channel capacity and noise models.
4. Study error detection and correction techniques.
5. To understand the theoretical framework upon which error-control codes are designed.

Course Outcomes:

1. Understand the significance of this quantitative measure of information in the communication systems.
2. Design efficient data compression scheme for a given information source.
3. Evaluate channel performance and channel capacity of a system.
4. Design and implement error detecting and correcting codes.
5. Evaluate the error correction capability of convolutional codes.
6. Understand the key concepts of lossy and lossless compression techniques in standard audio and video signal representation.

Prerequisite: Engineering Mathematics - IV



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Information Theory	Introduction to Probability theory: Axiomatic definition of probability, Bayes Theorem. One random variable: Types of random variable, Discrete & Continuous, PMF, PDF and Cumulative Distribution Function, Conditional Probability, Independent Event. Two Random Variable: Discrete and Continuous, Joint probability density function, Joint Distribution function, Marginal probabilities, Joint Conditional Probability. Concept of amount of information, information units, Entropy: marginal, conditional, joint and relative entropies, Relation among entropies Mutual information, information rate.	07	CO1
II	Source Coding Techniques	Block Diagram of Digital Communication system. Encoding techniques, Purpose of encoding, Instantaneous codes, Construction of instantaneous codes, Kraft's inequality, Coding efficiency and redundancy.	06	CO2

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		Source coding theorem. Construction of basic source codes: Shannon Fano coding. Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel -Ziv Algorithm-LZW.		
III	Information Channels	Information Channels: Communication Channels Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity. Discrete Memoryless channels: Binary Symmetric Channel (BSC), Channel Capacity of BSC, redundancy and efficiency of channels. Channel Capacity: Hartley – Shannon law.	06	CO3
IV	Codes for error detection and correction	Parity check coding, Linear block codes, Error detecting and correcting capabilities. Generator and Parity check matrices, Standard array and Syndrome decoding, Hamming codes. Cyclic codes: Generator polynomial, Generator and Parity check matrices, Encoding of cyclic codes. Syndrome computation and error detection, Decoding of cyclic codes.	08	CO4

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V	Convolution Codes	Encoding and State, Tree and Trellis diagrams. Maximum likelihood decoding of convolutional codes, Viterbi algorithm, Sequential decoding -Stack algorithm. Interleaving techniques: Block and convolutional interleaving.	06	CO5
VI	Audio and Video Coding	Linear Predictive coding, code excited LPC, Perceptual coding, MPEG audio coders, Dolby audio coders. Video compression: Principles, Introduction to H.265& MPEG-4 Part 10 Video standards.	06	CO6
Total			39	

Text Books:

1. Simon Haykin, Communication Systems, 4th Edition, John Wiley and Sons.
2. Ranjan Bose, Information theory, coding and cryptography, 2nd Edition, Tata McGraw-Hill.
3. R. Togneri, C.J.S deSilva, Fundamentals of Information Theory and Coding Design, 1st Edition, Taylor and Francis.
4. Fred Halsall, Multimedia Communications, Applications Networks Protocols and Standards, Pearson Education, 1st Edition, Asia.

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Reference books:

1. Bernard Sklar, Digital Communications Fundamentals and Applications, 2nd Edition, Pearson Education Asia.
2. Taub and Schilling, Principles of Communication Systems, 2nd Edition, Tata McGraw-Hill.
3. Glover and Grant, Digital Communication, 2nd Edition, Pearson.
4. T. M. Cover, J. A. Thomas, Elements of Information Theory, 2nd Edition, Wiley.
5. Mark Nelson, Data Compression Book, 2nd Edition, BPB Publication.
6. Watkinson J, Compression in Video and Audio, 1st Edition, Focal Press, London.
7. R. McEliece, Theory of Information and Coding, 1st Edition, Cambridge University Press.

Online References:

Sr. No.	Website Name
1.	NPTEL course: https://nptel.ac.in/courses/117101053
2.	ModuleWise Notes: https://sites.google.com/jitd.in/kavitha-k-j/18ec54-information-theory-coding
3.	https://www.udemy.com/course/information-theory-and-error-control-coding/?srsltid=AfmBOorzI3YWnLOjIQboKtqJqKdLrUl3pP_7yp8e-UhUPiS8tgCySUWv&couponCode=NVDIN35



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract.	Tut.	Total
ECC554	Sensors and Applications	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration			
		IAT1	IAT2	Total					
ECC554	Sensors and Applications	20	20	40	60	2.5	--	--	100

Rationale :

Sensors play a vital role in modern technology, enabling systems to interact with the physical world by detecting and measuring environmental parameters such as temperature, pressure, light, motion, and more. The subject *Sensors and Applications* provides students with foundational knowledge about various types of sensors, their working principles, signal conditioning, and real-world integration. It emphasizes the

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application of sensors in fields such as IoT, healthcare, automation, robotics, and smart systems. By understanding sensor technologies and their practical applications, students are prepared to design and implement intelligent systems that respond effectively to real-time inputs, making them valuable contributors to emerging industries and innovation.

Course Objectives:

- 1) To understand the stages of product (hardware / software) design & development.
- 2) To learn different considerations of analog, digital & mixed circuit design.
- 3) To be acquainted with methods of PCB design & different tools used for the same.
- 4) To be aware of the importance of testing in the product design cycle.
- 5) To gain knowledge about various processes & importance of documentation.

Course Outcomes:

After successful completion of the course students will be able to:

1. Understand the concept of sensors and its characteristics.
2. Understand the practical approach in design of technology based on different sensors.
3. Learn various sensor materials and technology used in designing sensors.
4. Implement a prototype for demonstrating the application of the sensors.
5. Demonstrate problem solving & troubleshooting skills in sensor applications.

Course Prerequisite:

1. Concept of internal characteristics of passive elements like resistor, capacitor, inductor etc.
2. Diode and transistor
3. Working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Sensors Fundamentals and Characteristics Sensors, Signals and Systems	Sensor Classification–Physical, Mechanical, Electrical, Chemical, electro-chemical. Functional unit of sensor: receptor and transducer; Units of Measurements. Sensor Characteristics, Physical Principles of Sensing Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements	6	CO1
II	Interface Electronic Circuits	Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits. Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors Analog and digital filtering.	6	CO2
III	Sensors in Different Applications	Area Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors. Temperature Sensors; Biosensors, Gas sensors, proximity sensor. (Correlation of output with the parameter being measured	8	CO3

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		in engineering terms): Only Working principle of each type of sensors and transduction action (for example: detection of change in temperature and conversion to electrical quantity say resistance and corresponding correlation) Case study of Applications of sensors in Automotive, Manufacturing plants, digital devices such as mobile phone, house-hold instrument such as washing machine (name of various sensors and their usability in each of these applications).		
IV	Sensor Materials and Technologies	MEMS-cantilever based sensors and their types such as, accelerometer, gyroscopes: Structure, material used (polysilicon, Silicon etc), working principle, applications. Metal oxide semiconductor (Nano-particles) based sensors such as gas sensors, biomedical sensors, chemical sensors (Structure, material used, working principle, applications).	7	CO4
V	Smart Sensors	4-20 mA Current Loop Types of smart Sensors, Limitations of single sensor and applicability of Array- based sensor technology, Electronic-Nose sensors HART, Industrial buses such as Profibus, CAN bus, etc.	6	CO5
VI	Industrial standards for the sensors and its calibration	Basic knowledge about IEC 60601-1-1: Medical Electrical Equipment – Part 1- 1, ISA S82.01, NEMA standards PCI 6.5 to SOX compliance, HIPAA compliance, and FISMA compliance in	6	CO6

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		software development: Basic introduction about each of these standards, Calibration and compatibility.		
Total			39	

Text Books:

1. Jacob Fraden, Handbook of Modern Sensors Physics, Designs, and Applications, Fourth Edition, Springer.
2. D. Patranabis, Sensors and Transducers, 2nd Edition, PHI Publication, New Delhi.
3. Mechatronics- Ganesh S. Hegde, Published by University Science Press, 2nd Edition, An imprint of Laxmi Publication Private Limited.
4. Terry Bartelt, Process Control Systems and Instrumentation, Delmar Cengage Learning India Edition New edition

Reference Books:

1. G. Eranna , Metal Oxide Nanostructures as Gas Sensing Devices, Publisher: CRC Press
2. ISA S82.01 - Safety Standard for Electrical & Electronic Test, Measuring, Controlling Related Equipment

Online References:

Sr. No.	Website Name
<u>1</u>	www.nptel.ac.in
<u>2</u>	http://www.ebme.co.uk/arts/safety/part6.htm

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract	Tut.	Theory	Pract	Tut.	Total
ECL506	Communication Engineering Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ECL506	Communication Engineering Lab	--	--	--	--	25	25	50

Laboratory Outcomes:

After successful completion of the course students will be able to:

1. Perform hardware implementation of various analog and digital modulation methods.
2. Illustrate generation and detection of various pulse modulation techniques.
3. Apply techniques to insert Inter Symbol Interference and methods to mitigate its effect.

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4. Simulate various analog and digital modulation methods.
5. Demonstrate multiplexing and demultiplexing of signals using multiplexing techniques.
6. Illustrate the effect of sampling frequency on the reconstructed signal

Suggested List of Experiments.

Sr No	List of Experiments	Hrs
01	Analog Modulation and demodulation: AM	2
02	Analog Modulation and demodulation: FM	2
03	Pre-emphasis & De-emphasis	2
04	Analog Pulse modulation (PAM/PWM/PPM)	2
05	Time division multiplexing	2
06	Frequency division multiplexing	2
07	Verification of Sampling theorem	2
08	Generation of Line codes	2
09	Binary modulation and demodulation of BASK	2
10	Binary modulation and demodulation of BPSK	2
11	Binary modulation and demodulation of BFSK	2
	Simulation-based experiments	2
12	Simulation of AM and FM	2
13	Simulation of PAM, PPM, PWM	2



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14	Simulation of BPSK/BASK/MSK modulation	2
15	Simulation of duobinary encoder, decoder	2

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
ECL507	Software Engineering	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ECL507	Software Engineering	--	--	--	--	25	25	50

Lab Objectives:

1. Identify and analyze software requirements through real-world case studies and formal SRS documentation.
2. Model system design using UML diagrams such as use-case, class, sequence, and data flow diagrams.
3. Estimate project effort, time, and cost using standard software engineering models like COCOMO and function point analysis.
4. Apply software testing strategies (black-box and white-box) to validate and verify software modules.
5. Demonstrate version control and collaborative software development practices using Git and GitHub.

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6. Simulate Agile methodologies by planning and managing sprints using Scrum practices and project management tools.

Lab Outcomes:

- 1) Formulate a problem statement and analyze its feasibility from technical, operational, and economic perspectives.
- 2) Evaluate and select an appropriate software process model based on project requirements.
- 3) Develop a comprehensive SRS document in IEEE format capturing all software requirements.
- 4) Design a detailed project schedule using suitable project management tools.
- 5) Create UML diagrams including use case, class, activity, state transition, and sequence diagrams to model the system.
- 6) Apply testing techniques and estimation models like white-box testing and COCOMO to ensure software quality and effort estimation.

Suggested List of Experiments.

Sr No	List of Experiments	Hrs
01	Prepare a detailed statement of problem with feasibility study.	2
02	Identify suitable process models for the problem statement .	2
03	Develop Software Requirement Specification (SRS) document in IEEE format for the project.	2
04	Prepare schedule for the project using any project management tool	2
05	Prepare a RMMM plan for the project.	2



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06	Identify scenarios & develop UML Use case and Class Diagram for the project.	2
07	Develop Activity / State Transition diagram and Sequence diagram for the project.	2
08	Develop DFD for any problem statement .	2
09	Study of any testing tool (e.g. Selenium).	2
10	Develop test cases for the project using white box testing.	2
11	Effort and Cost Estimation using COCOMO Model	2

Sr No	List of Assignments / Tutorials	Hrs
01	Case study for RMMM .	2
02	Case study on requirement gathering	2

Text Books:

1. Roger S Pressman “Software Engineering: A Practitioner’s Approach” 8th Edition McGraw-Hill, ISBN:978-0-07-802212-8.
2. Pankaj Jalote, "An integrated approach to Software Engineering", Springer/Nar

References:

1. Ian Sommerville, “Software Engineering”, Pearson Education (9th edition).
2. Jibitesh Mishra and Ashok Mohanty, “Software Engineering”, Pearson edition.
3. Rajib Mall, "Fundamentals of Software Engineering", Prentice Hall India.



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4. Hans Van Vilet, "Software Engineering Principles and Practice" 3rd edition Wiley.

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
ECL508	Web Technologies Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL508	Web Technologies Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Designing and developing web applications using various technologies like HTML, CSS, JavaScript, and server-side programming languages
2. Debug and troubleshoot web development issues, enhancing their problem-solving skills.
3. Front-end and back-end development, databases, and web security.
4. Work on real-world projects, applying theoretical concepts to practical problems

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5. Deploy web applications on servers, understanding the process of making web applications live and accessible to users.
6. Web security best practices, learning to develop secure web applications that protect user data.

Lab Outcomes:

1. Create interactive web pages using HTML, CSS, JavaScript, and server-side programming languages.
2. Design web pages that adapt to different devices and screen sizes.
3. Integrate databases with web applications to store and retrieve data.
4. Understand security threats and implement measures to protect web applications from common vulnerabilities.
5. Develop skills to identify and fix errors in web applications.
6. Deploy web applications on servers or cloud platforms.

List of Experiments.

Sr No	List of Experiments	Hrs
01	a) Installation and Setting of LAMP / WAMP / XAMP.	2
	b) Develop a Prototype of the selected problem statement (UI and UX).	
02	Design and Implement web pages using HTML5 and CSS3 on the selected problem statement.	2
03	Design Form using javascript/HTML/JQuery with client-side validations on the selected problem statement.	2
04	Design Interactive web pages using PHP (any framework) with database connectivity to MySQL on the selected problem statement.	2
05	Design and Implement web pages with PHP and Ajax on the selected problem statement.	2
06	Enhance the web page designed in experiment number 2 using bootstrap.	2



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07	Design a registration form with:Text fields, radio buttons, checkboxes, and dropdowns.	2
08	Form validation using JavaScript,Validate email, password length, and confirm password match	2
09	Simple calculators using JavaScript perform basic arithmetic operations (add, subtract, multiply, divide).	2
10	Mini E-Commerce website,Home, Product List, Product Detail, Add to Cart (frontend only)	2

Text Books:

1. Ralph Moseley, M.T. Savliya , “Developing Web Applications”, Willy India, Second Edition,
2. “Web Technology Black Book”, Dreamtech Press, First Edition, 978-7722-997
3. Robin Nixon, "Learning PHP, MySQL, JavaScript, CSS & HTML5" Third Edition,O'REILLY,2014.(http://www.ebooksbucket.com/uploads/itprogramming/javascript/Learning_PHP_MySQL_Javascript_CSS_HTML5Robin_Nixon_3e.pdf)
4. Professional Rich Internet Applications: AJAX and Beyond, Dana Moore, Raymond Budd, Edward Benson, Wiley publications.
<https://ebooks-it.org/0470082801-ebook.htm>
5. Jennifer Kyrnin, “SAMS Teach Yourself Bootstrap in 24 hours”, 1st edition, Pearson Education.
6. Martin Bean, “Laravel 5 Essentials”, PACKT Publishing Ltd

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 Atul Kahate, “Web Technologies”, Second Edition, Tata McGraw Hill, 2012.
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



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6. Mike Mcgrath, “PHP & MySQL in easy Steps”, Tata McGraw Hill, 2012.
7. J. Millman and A. Grabel, “Head First HTML and CSS”, 2nd edition, O’ Reilly.
8. Ben Frain, “Responsive Web design with HTML5 and CSS3”, PACKT Publishing Ltd.
9. L. Welling and L. Thomson, “PHP and MySQL Web Development”, 4th edition, Adison Wesley Professional.

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
ECL509	Professional Communication and Ethics-II		2*+2	-	-	02	-	2

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Total					
ECL509	Professional Communication and Ethics-II	-	-	-	-		25	25	50

Rationale :

Professional Communication Ethics is an essential area of study for any aspiring professional because it ensures that communication—whether verbal, written, or digital—is truthful, responsible, respectful, and legally sound. In a professional setting, ethical communication builds credibility, promotes trust, and supports responsible decision-making.

Course Objectives:

1. Discern and develop an effective style of writing important



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technical/business documents.

2. Investigate possible resources and plan a successful job campaign.
3. Understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4. Develop creative and impactful presentation skills.
5. Analyse personal traits, interests, values, aptitude and skills.
6. Understand the importance of integrity and develop a personal code of ethics

Course Outcomes:

1. Plan and prepare effective business/ technical documents which will in turn provide solid foundation for their future managerial roles.
2. Strategize their personal and professional skills to build a professional image and meet the demands of the industry.
3. Emerge successful in group discussions, meetings and result-oriented agreeable solutions in group communication situations.
4. Deliver persuasive and professional presentations.
5. Develop creative thinking and interpersonal skills required for effective professional communication.
6. Apply codes of ethical conduct, personal integrity and norms of organizational behavior.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	ADVANCED TECHNICAL WRITING: PROJECT/PROBLEM BASED	Purpose and Classification of Reports Classification on the basis of: Subject Matter (Technology, Accounting, Finance, Marketing, etc.), Time Interval (Periodic, One-time, Special), Function (Informational,	6	CO1

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	LEARNING (PBL)	Analytical, etc.), Physical Factors (Memorandum, Letter, Short & Long) Parts of a Long Formal Report Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter) Language and Style of Reports Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables and Equations, Referencing Styles in APA& MLA Format, Proof-reading through Plagiarism Checkers Definition, Purpose & Types of Proposals Solicited (in conformance with RFP) & Unsolicited Proposals, Types (Short and Long proposals) Parts of a Proposal Elements, Scope and Limitations, Conclusion Technical Paper Writing Parts of a Technical Paper (Abstract, Introduction, Research Methods, Findings and Analysis, Discussion, Limitations, Future Scope and References), Language and Formatting, Referencing in IEEE Format		
II	EMPLOYMENT SKILLS	Cover Letter & Resume Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resume (Chronological, Functional & Combination) Statement of Purpose Importance of SOP, Tips for Writing an Effective SOP Verbal Aptitude Test Modelled on CAT, GRE, GMAT exams	6	CO2



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		Group Discussions Purpose of a GD, Parameters of Evaluating a GD, Types of GDs (Normal, Case-based & Role Plays), GD Etiquette Personal Interviews Planning and Preparation, Types of Questions, Types of Interviews (Structured, Stress, Behavioral, Problem Solving & Case-based), Modes of Interviews: Face-to-face (One-to one and Panel) Telephonic, Virtual		
III	BUSINESS MEETINGS	Conducting Business Meetings Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members, Meeting Etiquette Documentation Notice, Agenda, Minutes	2	CO3
IV	TECHNICAL/ BUSINESS PRESENTATIONS	Effective Presentation Strategies Defining Purpose, Analyzing Audience, Location and Event, Gathering, Selecting & Arranging Material, Structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a Presentation, Platform Skills Group Presentations Sharing Responsibility in a Team, Building the contents and visuals together, Transition Phases	2	CO4
V	INTERPERSONAL SKILLS	Interpersonal Skills Emotional Intelligence, Leadership & Motivation, Conflict Management & Negotiation, Time Management, Assertiveness, Decision Making	8	CO5

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		Start-up Skills Financial Literacy, Risk Assessment, Data Analysis (e.g. Consumer Behavior, Market Trends, etc.)		
VI	CORPORATE ETHICS	Intellectual Property Rights Copyrights, Trademarks, Patents, Industrial Designs, Geographical Indications Integrated Circuits, Trade Secrets (Undisclosed Information) Case Studies,Cases related to Business/ Corporate Ethicscessor architecture	2	CO6

LIST OF ASSIGNMENTS FOR TERMWORK:

(In the form of Short Notes, Questionnaire/ MCQ Test, Role Play, Case Study, Quiz, etc.)

1. Cover Letter and Resume
2. Short Proposal
3. Meeting Documentation
4. Writing a Technical Paper/ Analyzing a Published Technical Paper
5. Writing a SOP
6. IPR
7. Interpersonal Skills
8. Aptitude test (Verbal Ability)

Note:

1. The Main Body of the project/book report should contain minimum 25 pages (excluding Front and Back matter).
2. The group size for the final report presentation should not be less than 5 students or exceed 7 students.
3. There will be an end-semester presentation based on the book report.

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GUIDELINES FOR INTERNAL ASSESSMENT

Term Work:

Term work shall consist of a minimum 8 experiments.

The distribution of marks for term work shall be as follows:

Assignment : 10 Marks

Attendance : 5 Marks

Presentation slides : 5 Marks

Book Report (hard copy) : 5 Marks

The final certification and acceptance of term work ensures the satisfactory performance of

laboratory work and minimum passing in the term work.

Internal oral:

Oral Examination will be based on a GD & the Project/Book Report presentation.

Group Discussion :10 marks

Project Presentation :10 Marks

Group Dynamics :5 Marks

Text Books & Reference book:

1. Arms, V. M. (2005). Humanities for the engineering curriculum: With selected chapters from

Olsen/Huckin: Technical writing and professional communication, second edition. Boston,

MA: McGraw-Hill.

2. Bovée, C. L., &Thill, J. V. (2021). Business communication today. Upper Saddle River, NJ:

Pearson.

3. Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA:

Cengage Learning.



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4. Masters, L. A., Wallace, H. R., & Harwood, L. (2011), Personal development for life and work. Mason: South-Western Cengage Learning.
5. Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational behaviour. Harlow, England: Pearson.
6. Meenakshi Raman, Sangeeta Sharma (2004) Technical Communication, Principles and Practice. Oxford University Press
7. Archana Ram (2018) Place Mentor, Tests of Aptitude For Placement Readiness. Oxford University Press
8. Sanjay Kumar & Pushp Lata (2018). Communication Skills a workbook, New Delhi: Oxford University Press.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL510	Mini Project-2 A	-	-	-	-	-	-	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECL510	Mini Project-2A	-	-	-	-	-	25	25	50

Rationale :

A mini project provides students with hands-on experience in applying theoretical knowledge to real-world problems. It enhances practical skills, encourages innovation, and strengthens problem-solving and teamwork abilities. Through the mini project, students learn to plan, design, and implement solutions, which prepares them for larger projects, research, or industry challenges in the future.

Course Objectives:

1. To acquaint with the process of identifying the needs and converting it into the problem.

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2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcomes:

1. Identify problems based on societal /research needs.
2. Apply knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Draw the proper inferences from available results through theoretical/experimental/simulations.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices.
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life-long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for mini projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Major focus of Mini-project 2 shall be towards exploration and applicability of knowledge acquired in the domain areas of DLOs available for the year.
- Students shall give special consideration to identify and provide solutions to the burning societal and/or environmental issues which may affect mankind to a larger extent.
- Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.



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A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.

- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self- learning.
- Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/supervisor.
- Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case-to-case basis.

Guidelines for Assessment of Mini Project:

The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, minimum two reviews in each semester. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

Distribution of Term work marks for both semesters shall be as below;

Marks awarded by guide/supervisor based on logbook : 10

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Marks awarded by review committee **10**

Quality of Project report **05**

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

In the first **semester the entire** theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the student group.

- First on identification and finalization of problem
- Second on the proposed solution for the problem.

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 shall be based on readiness of building working prototype.
- Second review shall be based on poster presentation-cum-demonstration of working model in the last month of the said semester.

Half-year project:

In this case students' group shall complete project in all aspects, in a semester, including;

- Identification of need/problem
- Proposed acceptable solution for the identified problem
- Procurement of components/systems, if any,
- Building a working prototype and testing

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The group shall be evaluated twice during the semester by review committee, mainly look for the progress as;

- First review focus shall be towards identification & selection of problem and probable solution proposal.
- Second review shall be for implementation and testing of the solution.
(Innovative/out of box solution)

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Innovativeness and out of box thinking
6. Cost effectiveness and Societal impact
7. Functional working model as per stated requirements
8. Effective use of skill sets acquired through curriculum including DLOs
9. Effective use of standard engineering practices & norms
10. Contribution of an individual as team member/Leader
11. Feasibility to deploy the solution on large scale
12. Clarity in written and oral communication

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In **one year, project**, first semester evaluation may be based on the first six criteria and the remaining may be used for the second semester evaluation of performance of students in the mini-project.

In **case of half year project** all criteria's in generic may be considered for performance evaluation of students in mini-project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

Report should be prepared as per the guidelines issued by the University of Mumbai. Mini Project shall be assessed through a presentation and demonstration of the 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 the Institute.

Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

The Mini Project shall be assessed by a team of external & internal examiners at the end of semester/year. Performance shall be evaluated based on;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Implementation of working model
5. Effective use of diversified skill-set
6. Effective use of standard engineering practices & norms
7. Contribution of an individuals as a member/Leader
8. Clarity in written and oral communication



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SEM VI



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC601	Embedded Systems & RTOS	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
ECC601	Embedded Systems & RTOS	20	20	40	60	2.5	--	--	100

Course Objectives:

1. To explain the characteristics, requirements, and constraints of real-time systems.
2. To study concepts involved in Embedded Hardware and Software for System realization.
3. To learn how embedded systems interact with the real world through sensors, actuators, and other peripheral interfaces.
4. To learn the concepts of modern microcontroller cores like the ARM-Cortex
5. To understand the features of RTOS including task scheduling, inter-task communication, synchronization, and memory management.

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6. To prepare students to design, develop, and analyze embedded systems using RTOS in industrial and consumer electronics.

Course Outcomes:

1. Identify and describe various characteristic features and applications of Embedded systems.
2. Analyze and select hardware for Embedded system implementation.
3. Evaluate various communication protocols for Embedded system implementation.
4. Compare GPOS and RTOS and investigate the concepts of RTOS.
Evaluate and use various tools for testing and debugging embedded systems
5. Design a system for different requirements based on life-cycle for the embedded system, keeping oneself aware of ethics and environmental issues.

Prerequisite: Digital Electronics (ECC 303), Microprocessors and Microcontrollers (ECC 404)

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction To Embedded Systems	1.1 Definition, Characteristics, Classification, Applications 1.2 Design metrics of Embedded system and Challenges in optimization of metrics Self-learning Topics: Real life embedded systems examples	03	CO1



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II	Embedded Hardware Elements	2.1-Features of Embedded cores- μ C, ASIC, ASSP, SoC, FPGA, RISC and CISCcores. Types of memories. 2.2-Case Study: ARM Cortex-M3 Features, Architecture, Programmer's model, Special Registers, Operating Modes and States, MPU, Memory map and NVIC. 2.3-Low power: - Need and techniques. Case study of Low Power modes in Cortex-M3. 2.4-Communication Interfaces: Comparative study of Serial communication Interfaces (RS-232, RS-485), SPI, I2C, CAN, USB (v2.0), Bluetooth, Zig-Bee. (Frame formats of above protocols are not expected) 2.5-Selection criteria of Sensors and Actuators Self-learning Topics: Study various sensors	13	CO2
III	Embedded Software	3.1-Program Modelling concepts: DFG, CDFG, FSM. 3.2-Real-time Operating system: - Need of RTOS in Embedded system software and comparison with GPOS, Task, Task states, Multi-tasking, Task scheduling, and Algorithms-Preemptive SJF, Round-Robin, Priority, Rate Monotonic Scheduling, Earliest Deadline First. Inter-process communication: Message queues, Mailbox, Event timers. Task synchronization: Need, Issues - Deadlock, Race condition, live Lock, Solutions using Mutex, Semaphores. Shared data problem, Priority inversion.	12	CO3
IV	Introduction to Free RTOS	Free RTOS Task Management features, Resource Management features, Task Synchronization features, Event Management features, Calculate the CPU Utilization of an RTOS, Interrupt Management features, Time Management features. Self-learning Topics: Study task management of some real life systems	03	CO4



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V	Testing and Debugging Methodology	5.1-Testing & Debugging: Hardware testing tools, Boundary-scan/JTAG interface concepts, Emulator. 5.2-Software Testing tools, simulator, debugger. White-Box and Black-Box testing.	02	CO5
VI	System Integration (Case Studies)	6.1-Embedded Product Design Life-Cycle (EDLC)- Waterfall Model 6.2-Hardware-Software Co-design 6.3-Case studies for Automatic Chocolate Vending Machine, Washing Machine, Smart Card, highlighting i) Specification requirements (choice of components), ii) Hardware architecture iii) Software architecture Self-learning Topics: Identify other Embedded products	06	CO6
	Total			39

Text Books:

1. Dr. K. V. K. K. Prasad, “Embedded Real Time System: Concepts, Design and Programming”, Dreamtech, New Delhi, Edition 2014.
2. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, McGraw Hill Education (India) Private Limited, New Delhi, 2015, 3rd Edition.
3. Sriram Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata McGraw Hill Publishing Company Ltd., 2003.
4. Joseph Yiu, “The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors”, Elsevier, 2014, 3rd Edition.
5. www.freertos.org

References:

1. David Simon, “An Embedded Software Primer”, Pearson, 2009.



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R-2025- T.E (SEM VI) Electronics and Computer Science

2. Jonathan W. Valvano, “Embedded Microcomputer Systems – Real Time Interfacing”, Publisher - Cengage Learning, 2012 3rd Edition.
3. Andrew Sloss, Domnic Symes, Chris Wright, “ARM System Developers Guide Designing and Optimising System Software”, Elsevier, 2004.
4. FrankVahid, Tony Givargis, “Embedded SystemDesign–A Unified Hardware/SoftwareIntroduction”, John Wiley & Sons Inc., 2002.
5. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, New Delhi,2009

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs54/
2.	https://archive.nptel.ac.in/courses/106/105/106105193/
3.	https://vtudeveloper.in/6th-semester-ece-embedded-system-design.php#google_vignette



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.		Total
ECC602	Artificial Intelligence	3	-	-	3	-	-	3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total.					
ECC602	Artificial Intelligence	20	20	40	60	2.5	--	--	100

Rationale:

Artificial Intelligence (AI) is the field of computer science that focuses on creating systems capable of performing tasks that typically require human intelligence, such as learning, reasoning, problem-solving, and decision-making. The rationale for studying AI lies in its ability to solve complex real-world problems, automate repetitive tasks, enhance human capabilities, and drive innovation across sectors like healthcare,

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education, transportation, and industry. AI is also crucial for economic growth, scientific research, and the development of smart systems,

making it a strategic technology for future advancements. Understanding AI is essential to ensure its ethical and responsible use in society.

Course Objectives:

1. To gain perspective of AI and its foundations.
2. To study different agent architectures and properties of the environment.
3. To understand the basic principles of AI towards problem solving, inference, perception, knowledge representation and learning.
4. To investigate probabilistic reasoning under uncertain and incomplete information.
5. To explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes:

1. **Understand** the fundamental concepts and history of Artificial Intelligence.
2. **Identify** the characteristics of the environment and differentiate between various agent architectures.
3. **Apply** the most suitable search strategy to solve real-world AI problems.
4. **Represent** a natural language description of statements in logic and apply the inference rules to design Knowledge Based agents.
5. **Apply** a probabilistic model for reasoning under uncertainty.
6. **Evaluate** various machine learning in AI applications and **explore** the ethical implications and real-world applications of AI in expert systems.



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Artificial Intelligence	Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally. History of AI, Applications of AI, The present state of AI, Ethics in AI.	03	CO1
II	Intelligent Agents	Introduction of agents, Structure of Intelligent Agent, Characteristics of Intelligent Agents. Types of Agents, Simple Reflex, Model Based, Goal Based, Utility Based Agents. Environment Types, Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent.	04	CO2
III	Solving Problems by Searching	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems. Solving Problems by Searching, Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality. Uninformed Search, Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search. Informed Search, Heuristic Function, Admissible Heuristic, Informed Search Technique, Greedy Best First Search, A* Search, Local Search, Hill Climbing Search, Simulated Annealing Search, Optimization, Genetic Algorithm.	12	CO3

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		Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning.		
IV	Knowledge and Reasoning	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems. Propositional Logic (PL), Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula. Predicate Logic, FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL, Introduction to logic programming (PROLOG). Forward Chaining, Backward Chaining and Resolution in FOPL.	10	CO4
V	Reasoning Under Uncertainty	Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution. Bayes' Rule and its use, Bayesian Belief Networks, Reasoning in Belief Networks.	05	CO5
VI	Planning and Learning	The planning problem, Partial order planning, total order planning. Learning in AI, Learning Agent, Concepts of Supervised, Unsupervised, Semi-Supervised Learning, Reinforcement Learning, Ensemble Learning. Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems.	05	CO6
Total			39	

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Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach —Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight —Artificial Intelligence Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. George F Luger "Artificial Intelligence" Low Price Edition, Pearson Education., Fourth edition.

References:

1. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3. Saroj Kaushik "Artificial Intelligence", Cengage Learning.
4. Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
5. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, Third Edition.
6. N. P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Online References:

Sr. No.	Website Name
1.	NPTEL COURSE: https://youtu.be/uB3i-qV6VdM?feature=shared
2.	Prof. Mausam: https://youtu.be/GHpchgLoDvI?feature=shared
3.	GeeksforGeeks: https://www.geeksforgeeks.org/what-is-artificial-intelligence-ai/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC603	Computer Networks	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC603	Computer Networks	20	20	40	60	2	--	--	100

Rationale :

Computer Networks is a core subject that teaches students how data is transmitted and shared across interconnected systems. It covers key concepts like network models, protocols, IP addressing, and routing. With the growing importance of the internet, cloud computing, and cybersecurity, understanding network architecture and communication is essential for careers in IT, networking, and system administration.

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Course Objectives:

1. To understand the fundamental concepts of computer networking, protocols, architectures, and applications.
2. To study the multiple layer design issues, services, and state-of-the-art protocols of TCP/IP and OSI based Architectures.
3. To help students to acquire knowledge of address in the configuration of various scales of networks.
4. To explore and evaluate protocols at various layers such as MAC protocols, IP addressing, routing algorithms, transport layer mechanisms, and application layer services.
5. To be conversant with the principles of Network Application Programming.
6. To introduce network security concepts and challenges, covering firewalls, encryption, authentication, and secure communication protocols.

Course Outcomes:

1. Enumerate the layers of OSI model and TCP/IP model and describe their functions.
2. Identify the characteristics of network devices and media used to design networks.
3. Demonstrate the knowledge of networking protocols at various layers of TCP/IP model.
4. Classify the routing protocols and analyse how to assign the IP addresses for a given network.
5. Design and configure the networks using IP addressing and sub-netting / super-netting schemes.
6. Explain the functions of Application layer and Presentation layers, their paradigms and

Prerequisite:

- 1) Communication Engineering

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Data Communications and Networking	Introduction to computer networks, Network software, Layers and services, Network topologies, protocol hierarchies, design issues for the layers, connection oriented and connectionless services. Reference models: Layer details of OSI, TCP/IP models. Communication between layers.	5	CO1
II	Physical Layer	Guided Transmission Media: Twisted pair, Coaxial, Fiber optics. Unguided media (Wireless Transmission): Radio Waves, Microwave, Bluetooth, Infrared, Circuit and Packet Switching Network Devices: Repeaters, Hubs, Switches, Routers and Gateways	6	CO2
III	Data Link Layer	DLL Design Issues - Services, Framing, Error Control, Flow Control, Error Detection and Correction 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), Local Area Networks - Ethernet (802.3), Introduction to wireless LAN: 802.11x	8	CO3
IV	Network layer	Network Layer design issues, Communication Primitives: Unicast, Multicast, Broadcast. Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses, IPv4 Addressing (classfull and	8	CO4

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		classless), Sub-netting and Super-netting design problems, IPv4 Protocol, IPv6 Packet Format, IPv6 Addressing, Transition from IPv4 to IPv6 Routing algorithms: Intra-domain Routing -Shortest Path, Distance Vector Algorithms, Link State Routing, Inter-domain Routing Protocols. Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters.		
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	5	CO5
VI	Application layer	Application layer Paradigms, Client-Server Paradigm: Application Programming Interface Standard Client Server applications: World Wide Web and HTTP, FTP, Electronic Mail, TELNET, Secure Shell (SSH), Domain Name System (DNS).	6	CO6

Text Books:

1. Andrew S Tanenbaum, Computer Networks -, 4th Edition, Pearson Education
2. Behrouz A. Forouzan, Forouzan Mosharrat, Computer Networks A Top down Approach, McGraw Hill education
3. Ranjan Bose, Information Theory, Coding and Cryptography, Ranjan Bose, Tata McGraw Hill, Second Edition.

References:

1. James F. Kurose, K. W. Ross, Computer Networking: A Top-Down Approach Featuring the Internet, 3rd Edition, Pearson Education.

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2. S. Keshav, An Engineering Approach to Computer Networks, 2nd Edition, Pearson Education.
3. W. A. Shay, Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning.
4. L. L. Peterson and B. S. Davie, Computer Networks: A Systems Approach, 4th Ed, Elsevier India

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/106/105/106105183/
2.	https://nptel.ac.in/courses/106105183



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC604	Data WareHousing and Mining	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC604	Data WareHousing and Mining	20	20	40	60	2.5	--	--	100

Rationale :

This course provides a comprehensive overview of data warehousing and data mining techniques, applying these skills to support Sustainable Development Goals and equip students with data-driven solution design and implementation skills.

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Course Objectives:

1. To introduce the fundamental concepts, architecture, and schema designs of data warehouses and differentiate them from traditional database systems.
2. To understand the ETL process and OLAP operations essential for data integration and multidimensional analysis.
3. To familiarize learners with the data mining process and data pre-processing techniques needed for effective knowledge discovery.
4. To explore association rule mining methods for identifying patterns and relationships in transactional datasets.
5. To enable learners to build classification and prediction models for decision-making using machine learning techniques.
6. To understand and apply clustering algorithms for grouping and analyzing data based on similarities.

Course Outcomes:

1. Explain the architecture, characteristics, and schema models of data warehousing, and differentiate between OLTP and OLAP systems.
2. Design and implement ETL processes and apply OLAP operations such as slice, dice, and drill-down to support multidimensional data analysis.
3. Apply data pre-processing techniques such as cleaning, transformation, and reduction to prepare datasets for mining.
4. Implement association rule mining techniques like Apriori and FP-Growth to discover frequent patterns in transaction data.
5. Develop classification and prediction models using algorithms such as Decision Trees, Logistic Regression, and Bayesian techniques.
6. Apply clustering algorithms like K-Means and Hierarchical Clustering to group data based on similarity measures.

Prerequisite: Database Management Systems, Introduction to Data Structures, Programming (Python)



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Data Warehousing and Dimensional Modeling	Introduction to Data Warehousing: Concepts, Characteristics, and Applications, Architecture & Components of a DW system, Data Warehouse vs. Data Marts, E-R Modelling vs. Dimensional Modelling, Schema Design: Star, Snowflake, Factless, and Constellation, Fact and Dimension Tables, OLTP vs. OLAP Systems.	8	CO1
II	ETL and OLAP	ETL Process: Extraction, Transformation, and Loading, Extraction Methods, Data transformation techniques for noisy, incomplete data, Data Loading Techniques, Multidimensional Data, OLAP Models, OLAP Operations: Slice, Dice, Pivot, Drill-down/Roll-up.	6	CO2
III	Data Mining and Pre-processing	Introduction to Data Mining and Architecture, Knowledge Discovery in Databases (KDD), Data Cleaning, Summarization, Integration, Reduction, Data Transformation, Discretization, and Hierarchies, Issues and Classifications in Data Mining.	6	CO3
IV	Pattern Mining & Association Analysis	Market Basket Analysis, Frequent & Closed Itemsets, Apriori Algorithm and Optimization, Association Rule Generation, Improving the Efficiency of Apriori, FP-Growth Algorithm, Mining Multilevel and Multidimensional Rules.	7	CO4
V	Classification & Prediction	Decision Trees & Bayesian Classification, Linear and Logistic Regression, Prediction Techniques and Use Cases, Accuracy & Error Metrics.	5	CO5
VI	Cluster Analysis	Clustering Definition, Distance Measures, K-Means and K-Medoids, Hierarchical Clustering.	7	CO6



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Text Books:

1. Paulraj Ponniah, - "Data Warehousing: Fundamentals for IT Professionals", Wiley India.
2. Han, Kamber - "Data Mining Concepts and Techniques", Morgan Kaufmann
3. Reema Theraja - "Data warehousing, Oxford University Press.
4. M.H. Dunham - "Data Mining Introductory and Advanced Topics", Pearson Education

References:

1. Ian H. Witten, Eibe Frank and Mark A. Hall " Data Mining ", 3rd Edition Morgan Kaufmann publisher.
2. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining", Person Publisher

Online References:

Sr. No.	Website Name
1.	https://www.coursera.org/specializations/data-mining
2.	https://www.udemy.com/course/data-mining-python/
3.	https://onlinecourses.nptel.ac.in/noc21_cs06/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC651	Machine Learning	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract /Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC651	Machine Learning	20	20	40	60	2.5	--	--	100

Rationale :

Machine Learning enables systems to learn from data and make decisions without explicit programming. It equips students with essential skills to build predictive models and apply algorithms to real-world problems. ML is widely used in areas like healthcare, finance, and automation, making it vital for careers in AI and data science.

Course Objectives:

1. To introduce Machine learning concepts.
2. To develop mathematical concepts required for Machine learning algorithms.
3. To understand various Regression techniques.

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4. To understand Clustering techniques.
5. To develop Neural Network based learning models.
6. To apply dimensionality reduction techniques.

Course Outcomes:

1. Explain fundamental concepts and applications of Machine Learning in various domains.
2. Apply linear algebra, probability, and calculus to formulate and solve Machine Learning problems.
3. Compare and analyze the performance of different regression techniques such as linear, polynomial, and logistic regression.
4. Evaluate clustering algorithms like K-means and hierarchical clustering for effectiveness on different datasets.
5. Design and implement a basic neural network model using appropriate tools and datasets.
6. Use different techniques to reduce the dimensionality of data and interpret the results.

Prerequisite:

Data Structures, Basic Probability and Statistics, Algorithms



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction to Machine Learning	1.1 Introduction to Machine Learning, Issues in Machine Learning, Application of Machine Learning, Steps of developing a Machine Learning Application. 1.2 Supervised and Unsupervised Learning: Concepts of Classification, Clustering and prediction, Training, Testing and validation dataset, cross validation, overfitting and under fitting of model 1.3 Performance Measures: Measuring Quality of model- Confusion Matrix, Accuracy, Recall, Precision, Specificity, F1 Score, RMSE	6	CO1
II	Mathematical Foundation for ML	2.1 System of Linear equations, Norms, Inner products, Length of Vector, Distance between vectors, Orthogonal vectors 2.2 Symmetric Positive Definite Matrices, Determinant, Trace, Eigenvalues and vectors, Orthogonal Projections, Diagonalization, SVD and its applications.	5	CO2
III	Linear models	3.1 The least-squares method, Multivariate Linear Regression, Regularised Regression, Using Least-Squares Regression for classification 3.2 Support Vector Machines	7	CO3
IV	Clustering	4.1 Hebbian Learning rule 4.2 Expectation -Maximization algorithm for clustering	4	CO4



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V	Classification models	5.1 Introduction, Fundamental concept, Evolution of Neural Networks, Biological Neuron, Artificial Neural Networks, NN architecture, McCulloch-Pitts Model. Designing a simple network, Non-separable patterns, Perceptron model with Bias. Activation functions, Binary, Bipolar, continuous, Ramp. Limitations of Perceptron. 5.2 Perceptron Learning Rule. Delta Learning Rule (LMS-Widrow Hoff), Multi-layer perceptron network. Adjusting weights of hidden layers. Error back propagation algorithm. 5.3 Logistic regression	12	CO5
VI	Dimensionality Reduction	6.1 Curse of Dimensionality. 6.2 Feature Selection and Feature Extraction 6.3 Dimensionality Reduction Techniques, Principal Component Analysis.	5	CO6
	Total		39	

Text Books:

1. Nathalie Japkowicz & Mohak Shah, "Evaluating Learning Algorithms: A Classification Perspective", Cambridge.
2. Marc Peter Deisenroth, Aldo Faisal, Cheng Soon Ong, "Mathematics for machine learning"
3. Samir Roy and Chakraborty, "Introduction to soft computing", Pearson Edition.
4. Ethem Alpaydın, "Introduction to Machine Learning", MIT Press
5. Peter Flach, "Machine Learning", Cambridge University Press.

References:

1. Tom M. Mitchell, "Machine Learning", McGraw Hill
2. Kevin P. Murphy, "Machine Learning — A Probabilistic Perspective", MIT Press
3. Stephen Marsland, "Machine Learning an Algorithmic Perspective", CRC Press



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4. Shai Shalev-Shwartz, Shai Ben-David, “Understanding Machine Learning”, Cambridge University Press
5. Peter Harrington, “Machine Learning in Action”, DreamTech Press

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs18/preview
2.	http://ndl.iitkgp.ac.in/he_document/e_adhyayan/eadhyayan/IN_e_A_1_C_S_395_M_L_443_444?e=0 machine%20learning

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.		Total
ECC652	Industrial Automation	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work		Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC652	Industrial Automation	20	20	40	60	2.5	--	--	100

Rationale:

The study of industrial automation is crucial for several reasons: it drives increased productivity, enhances product quality, reduces costs, and improves safety by automating tasks and processes. It also fosters innovation and promotes sustainable practices. Furthermore, the increasing adoption of automation technologies across various industries necessitates skilled professionals to design, and maintain these systems.

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Course Objectives:

1. To measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.
2. To explain fundamentals of process control
3. To list basic devices used in automated systems
4. To use programmable logic controllers for industrial automation
5. To draw block diagram of supervisory control and data acquisition (SCADA) and integrate it with PLC systems
6. To use Internet of Things for Industrial Automation
7. To make use of robots for industrial applications

Course Outcomes:

1. Understand and draw block diagram of industrial automation and control systems.
2. Understand various automation components and systems.
3. Explain architecture of industrial automation systems.
4. Demonstrate working of PLC and SCADA and interface the same.
5. Demonstrate the use of IOT and robotics in Automation.
6. Distinguish between the usage of custom embedded systems, FPGAs and PLCs.

Prerequisite: Knowledge of Basic Electrical Engineering, Basic Electronics, Digital Electronics, Electronics Measurement and Instruments

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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Introduction	Architecture of Industrial Automation system, Parameters of Industrial Revolution 4.0. Introduction of PLC and supervisory control and data acquisition (SCADA). Industrial bus systems: Mod bus & Profi-bus & Ether CAT	06	CO1
II	Automation components	Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, Introduction of DC and AC servo drives formation control. Use of Contactors, Isolators, MCB, MCCB, Earth Breakers etc	07	CO2
III	Computer aided measurement and control systems	Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer	08	CO3

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		based data acquisition system. Internet of things (IoT) for plant automation		
IV	Programmable logic controllers	Programmable controllers, Programmable logic controllers, Analog digital input and output modules. PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking. PLC selection, PLC Installation, Advantage of using PLC for Industrial, automation, Application of PLC to process control industries.	6	CO4
V	Distributed Control System	Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS	06	CO5
VI	Overview of Industrial automation using robots	Basic construction and configuration of robot Pick and place robot, Welding robot. Robots in the medical field.	06	CO6
Total			39	

Text Books:

1. S. K. Singh, "Industrial Instrumentation and Control", The McGraw Hill Companies
2. C.D. Johnson, "Process Control Instrumentation Technology", PHI
3. E. Andrew Parr, "Industrial control handbook", Newnem publication

Reference Books:

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1. Garry Dunning, Introduction to Programmable logic controller, Delmar Thomson Learning.
2. Norman A. Anderson, Instrumentation and Process measurements and Control 2nd Edition. CRC Press.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/108/105/108105062/
2.	https://www.machinemetrics.com/blog/industrial-automation
3.	https://www.clarify.io/learn/industrial-automation



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC653	Digital Signal Processing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC653	Digital Signal Processing	20	20	40	60	2.5	--	--	100

Rationale :

Digital Signal Processing equips students with the skills to analyze and process digital signals, design filters, and implement real-time applications using DSP processors, essential for careers in communications, control, and embedded systems.

Course Objectives:

1. To make conversant with the fundamentals of digital signal processing
2. To familiarise with the transforms used in Digital Signal Processing
3. To familiarise with the design techniques and performance analysis of digital filters
4. To introduce digital signal processors and applications



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Course Outcomes:

On successful completion of the course learner will be able to:

1. Analyze and manipulate discrete-time signals and systems using standard operations and classifications, including convolution and system responses.
2. Apply DTFT and Z-transform techniques to examine and characterize the behavior of discrete-time LTI systems in the frequency domain..
3. Compute and interpret the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) for efficient spectral analysis of signals.
4. Design and implement IIR digital filters using techniques such as bilinear transformation and impulse invariance for given frequency specifications.
5. Design FIR digital filters using windowing techniques and analyze their frequency response and phase characteristics.
6. Utilize DSP processors and associated hardware for implementing real-time signal processing applications in areas like radar and speech processing.

Prerequisite: Engineering Mathematics - III

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Discrete-Time Signal and Discrete-Time Systems	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, LTI system, Impulse Response. Linear Convolution, Circular Convolution- Emphasis on graphical method,	8	CO1

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		Linear convolution using Circular Convolution. Software simulation - Impulse Response, Step Response, convolution, Correlation.		
II	Frequency Domain Analysis using DTFT and Z Transform	Introduction to DTFT. Properties of DTFT. Z transform - definition, properties of unilateral and bilateral Z Transform, Z transform of standard signals, ROC, poles and zeros of transfer function, Inverse Z transform Analysis and characterization of LTI system using Z transform, impulse and step response, causality, stability, stability of causal system	7	CO2
III	Discrete Fourier Transform and Fast Fourier Transform	IDFT, Relation between DFT and DTFT, IDFT Properties of DFT, circular convolution of sequences using DFT. Fast Fourier transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT	6	CO3
IV	IIR Digital Filters	Comparison of IIR and FIR filters, Types of IIR Filters, Analog filter approximations: Butterworth, Chebyshev I and II. Mapping of S-plane to Z-plane, impulse invariance method, bilinear transformation method, Design of IIR digital filters from analog filters with examples, Software simulation – Design of IIR Filters Analog and digital frequency transformations.	9	CO4
V	FIR Digital Filters	Characteristics of FIR digital filters, Minimum Phase, Maximum Phase, Mixed Phase and Linear Phase Filters Frequency response, location of the zero of linear phase FIR filters, Design of FIR filters using window techniques	5	CO5



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		-Rectangular, Hamming, Hanning, Blackman, Bartlett, Software simulation – Design of FIR Filters.		
VI	DSP Processors and Applications	General purpose digital signal processors, DSP processor architecture, Selecting digital signal processors, Special purpose DSP hardware, Applications of DSP: Radar Signal Processing and Speech Processing.	4	CO6

Text Books:

1. Emmanuel C. Ifeakor, Barrie W. Jervis, “*Digital Signal Processing*”, A Practical Approach by Pearson Education – Second edition.
2. Tarun Kumar Rawat, “*Digital Signal Processing*”, Oxford University Press, 2015
3. S Salivahanan, A Vallavaraj, C Gnanapriya. “*Digital Signal Processing*” – TMH, 2007

References:

1. ProakisJ., Manolakis D., “*Digital Signal Processing*”, 4th Edition, Pearson Education.
2. Sanjit K. Mitra, “*Digital Signal Processing – A Computer Based Approach*”, edition 4e McGraw Hill Education (India) Private Limited.
3. Oppenheim A, Schafer R, Buck J., “*Discrete Time Signal Processing*”, 3rd Edition, Pearson
4. B. Venkata Ramani and, M. Bhaskar, “*Digital Signal Processors, Architecture, Programming and Applications*”, Tata McGraw Hill, 2nd edition 2017.
5. L. R. Rabiner and B. Gold, “*Theory and Applications of Digital Signal Processing*”, Prentice-Hall of India, 2015.

Online References:

Sr. No.	Website Name
1.	Khan Academy – Signals and Systems (for basics) https://www.khanacademy.org/science/electrical-engineering/ee-signals
2.	DSP Guide – The Scientist and Engineer's Guide to Digital Signal Processing https://www.dspguide.com/
3.	NPTEL – Digital Signal Processing by Prof. S. C. Dutta Roy (IIT Delhi) https://nptel.ac.in/courses/117101001

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.		Total
ECC654	Electronic Product Design	3	-	-	3	-		3

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC654	Electronic Product Design	20	20	40	60	2	--	--	100

Rationale :

Electronic Product Design equips students with the skills to develop real-world electronic systems from concept to prototype. It integrates knowledge of electronics, embedded systems, and design thinking to create user-centric, cost-effective, and sustainable products. The subject bridges theory and practice, fostering innovation, problem-solving, and industry readiness.

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Course Objectives:

1. To understand the customer need-based product development process.
2. To understand the Lab to market challenges in the product design and development.
3. To understand the electronic product development stages.
4. To understand the development consideration of hardware and software design and various testing methods.
5. To gain knowledge about various processes, safety & qualification certifications & the importance of documentation

Course Outcomes:

1. Importance of customer-centric approach in the electronic product development process.
2. Electronic product development stages and challenges.
3. Implement learning for meeting a prototype as per industry standard/specification.
4. Demonstrate problem-solving & troubleshooting skills in electronic product design.
5. Prepare the relevant set of design documentation & present it as a case study.

Course Prerequisite:

Concept of internal characteristics of passive elements like resistor, capacitor, inductor etc., Diode and transistor, Working, knowledge of basic fundamentals of mechanical terms like position, strain, stress etc



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DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	CUSTOMER CENTRIC APPROACH FOR PRODUCT DEVELOPMENT	Prototype, MVP, commercial product and related terminologies 1.2 Basics of customer discovery process, customer and value proposition. Understand product market fit, product failure, internal challenges for product development. Identify the available market place for the product.	08	CO1
II	PRODUCT DEVELOPMENT CHALLENGES	Idea segmentation, product features, lab to market journey, Product development stages, product development challenges. Electronic product classification and certifications requirement. Indian and International standard for product compliance.	06	CO2
III	HARDWARE DESIGN & TESTING METHODS	Design process, identifying the requirements, formulating specifications, design specifications, system partitioning, functional design, architectural design. Component selection criteria Functional model v/s architectural model, prototyping, performance & efficiency measures, formulating a test plan, writing all the specifications, test procedures & test cases, design reviews, module debug & testing – black box testing, white box testing, grey box testing.	07	CO3

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IV	SOFTWARE DESIGN & TESTING METHODS	Types of software, the waterfall model of software development, models, metrics & software limitations, risk abatement & failure prevention. Software bugs & testing. Good programming practice, user interface, embedded & real-time software.	06	CO4
V	PRODUCT DEBUGGING & TESTING	Steps of debugging, the techniques for troubleshooting Characterization, electromechanical components, passive components, active components, active devices, operational amplifier, analog-to-digital conversion, digital components. Inspection & testing of components, process of simulation, prototyping & testing, integration, validation & verification, EMI & EMC issues	06	CO5
VI	THE DOCUMENTATIO N PROCESS	Definition, needs & types of documentation, records, accountability & liability, audience, steps in preparation, presentation & preservation of documents Methods of documentation, visual techniques, layout of documentation, bills of materials, manuals – instructional or operating manual, service and maintenance manual. Fault finding tree, software documentation practices	06	CO6
	Total		39	



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Text Books:

1. Phillip Kotler, Kevin Lane Keller, Abraham Koshi, Mithieshwar Zha, "Marketing management" 13th edition
2. Alexander Osterwalder & Yves Pigneur, "Business model generation"
3. Alex Osterwalder, Yves Pigneur, Greg Bernarda, Alan Smith, "Value Proposition design"
4. G. C. Loveday, "Electronic Testing & Fault Diagnosis", 4th edition, A. H. Wheeler Publishing
5. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", 1st edition, Wiley Publication
1. J. C. Whitaker, "The Electronics Handbook", CRC Press

Reference Books

1. GIFF CONSTABLE, Talking to humans
2. R. G. Kaduskar & V. B. Baru, Electronic Product Design, 3rd edition, Wiley India
3. Kim Fowler, Electronic Instrument Design, 2nd edition, Oxford University Press.



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL606	Embedded Systems & ERTOS 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	Total				
ECL606	Embedded Systems & RTOS Lab	--	--	--	--	25	25	50

Prerequisite:

1. Basics of Microcontroller programming
2. C programming

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Laboratory Objectives:

1. To familiarize students with the hardware and software components of embedded systems.
2. To enable students to write, compile, and debug embedded C programs for microcontrollers.
3. To learn interfacing of I/O devices like LEDs, switches, LCDs, sensors, motors, etc., with microcontrollers.
4. To understand the basic concepts and architecture of RTOS, including tasks, scheduling, and inter-process communication.
5. To apply theoretical knowledge to solve real-world embedded system problems in a lab environment.

Laboratory Outcomes:

1. Interface various sensors and actuators to embedded cores.
2. Write code using RTOS for multi-tasking Embedded systems.
3. Design applications using different embedded cores.
4. To implement basic concepts and architecture of RTOS, including tasks, scheduling, and inter-process communication.
5. Able to solve real-world embedded system problems in a lab environment.



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Suggested List of Experiments:

Artificial Intelligence	
1	Interfacing of LEDs /switches with any embedded core. (8051/ARM/STM32, etc)
2	Interfacing of Temperature sensor with any embedded core. (8051/ARM/STM32, etc)
3	Interfacing of LCD/ Seven segment display with any embedded core. (8051/ARM/STM32,etc)
4	Interfacing of Ultrasonic/Humidity sensor with any embedded core. (8051/ARM/STM32,etc)
5	Interfacing of a relay with any embedded core. (8051/ARM/STM32,etc)
6	Interfacing of a DC motor (speed and Direction control) with any embedded core.(8051/ARM/STM32,etc)
8	Interfacing of a Servo/Stepper motor with any embedded core.(8051/ARM/STM32,etc)
9	Design of small project using any embedded core.(groupwise activity)
10	Write case study on given topic(groupwise).
11	Write a Program to Create Multiple Tasks and understand the Multitasking capabilities of RTOS(FreeRTOS).
12	Write a Program to illustrate the Queue Management Features of FreeRTOS.

Text Books:

1. Dr. K. V. K. K. Prasad, “Embedded Real Time System: Concepts, Design and Programming”, Dreamtech, New Delhi, Edition2014.
2. Rajkamal, “Embedded Systems: Architecture, Programming and Design”, McGraw Hill Education (India) Private Limited, New Delhi, 2015, 3rd Edition.
3. Sriram Iyer, Pankaj Gupta, “Embedded Real Time Systems Programming”, Tata McGraw Hill Publishing Company Ltd., 2003.
4. Joseph Yiu, “The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors”,Elsevier, 2014, 3rd Edition.
5. www.freertos.org



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References:

1. David Simon, “An Embedded Software Primer”, Pearson, 2009.
2. Jonathan W. Valvano, “Embedded Microcomputer Systems – Real Time Interfacing”, Publisher - Cengage Learning, 2012 3rd Edition.
3. Andrew Sloss, Dominic Symes, Chris Wright, “ARM System Developers Guide Designing and Optimising System Software”, Elsevier, 2004.
4. FrankVahid, Tony Givargis, “Embedded System Design – A Unified Hardware/SoftwareIntroduction”, John Wiley & Sons Inc., 2002.
5. Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, New Delhi, 2009

Online Resources:

Sr. No.	Website Name
1.	https://www.tinkercad.com/things/2Qck7pXpIfr-electronic-lab
2.	Silabs.com/mcu/32-bit-microcontrollers/arm-cortex-m3-32-bit-microcontroller

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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R-2025- T.E (SEM VI) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL607	Artificial Intelligence and Computer Networks 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	Total				
ECL607	Artificial Intelligence and Computer Networks Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To get familiar with AI programming tools and environments (such as Python, Prolog, or MATLAB).
2. To understand how agents perceive and act in an environment.

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3. To apply uninformed (e.g., BFS, DFS) and informed (e.g., A*, Greedy) search strategies.
4. To develop mini-projects integrating multiple AI components.
5. To set up and analyze various network topologies: star, bus, ring, mesh.
6. To study the layered structure of network models (OSI and TCP/IP).
7. To configure switches and routers using simulation tools or real devices.

Lab Outcomes:

1. Identify suitable Agent Architecture for a given real world AI problem
2. Implement simple programs using Prolog.
3. Implement various search techniques for a Problem-Solving Agent.
4. Represent natural language description as statements in Logic and apply inference rules to it.
5. Construct a Bayesian Belief Network for a given problem and draw probabilistic inferences from it.
6. Students will learn about and be able to identify and use different networking components, including hubs, switches, routers, and wireless access points.
7. Design and implement various network applications such as data transmission between client and server, file transfer etc. using Socket Programming.
8. Students will gain the ability to implement different network topologies, such as star, bus, ring, and mesh, using appropriate network devices and cables.

Suggested List of Experiments:

Artificial Intelligence	
1	Provide the PEAS description and TASK Environment for a given AI problem. Identify suitable Agent Architecture for the problem
2	Write simple programs using PROLOG as an AI programming Language.
3	Implement any one of the Uninformed search techniques
4	Implement any one of the Informed search techniques e.g. A-Star algorithm for 8 puzzle problem



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5	Prove goal sentence from the following set of statements in FOPL by applying forward, backward and resolution inference algorithms.
6	Create a Bayesian Network for the given Problem Statement and draw inferences from it. (You can use any Belief and Decision Networks Tool for modeling Bayesian Networks)
Computer Networks	
1.	Create and simulate different network topologies (Star, Bus, Ring, Mesh).
2	Assign static IP addresses and verify connectivity using ping.
3	Configure RIP (Routing Information Protocol) and observe dynamic routing.
4	Configure FTP Server and access it using a client PC.
5	Implement Email Communication using SMTP and POP3/IMAP between two PCs.
6	Configure a switch and connect multiple PCs to form a LAN.
7	Socket programming using TCP and/or UDP
8	Working with routing in Linux/Windows: (a) View the current routing table (b) Add and delete routes (c) Change default gateway (d) Perform IP Tables for IP forwarding

Note: Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that fundamentals & applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Text Books:

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach —Second Edition" Pearson Education.
2. Elaine Rich and Kevin Knight —Artificial Intelligence|| Third Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
3. George F Luger “Artificial Intelligence” Low Price Edition, Pearson Education., Fourth edition.



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References:

1. Ivan Bratko “PROLOG Programming for Artificial Intelligence”, Pearson Education, Third Edition.
2. D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3. Saroj Kaushik “Artificial Intelligence”, Cengage Learning.
4. Davis E. Goldberg, “Genetic Algorithms: Search, Optimization and Machine Learning”, Addison Wesley, N.Y., 1989.
5. Patrick Henry Winston, “Artificial Intelligence”, Addison-Wesley, Third Edition.
6. N. P. Padhy, “Artificial Intelligence and Intelligent Systems”, Oxford University Press.

Online Resources:

Sr. No.	Website Name
1.	Virtual Lab: https://ai2-iiith.vlabs.ac.in/
2.	OpenML – https://www.openml.org/
3.	PROLOG Online Compiler: https://onecompiler.com/prolog

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
ECL608	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	Total				
ECL608	Data Warehousing and Mining Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand data warehousing schemas and design a warehouse using dimensional modelling.
2. To implement ETL operations and OLAP functionalities for decision-making systems.
3. To perform data preprocessing operations on real-world datasets.
4. To apply association rule mining for pattern discovery.
5. To implement classification and prediction models on urban data.
6. To analyze real-world data using clustering techniques for resource planning and decision support.

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Lab Outcomes:

1. Design and implement data warehouse schemas using dimensional modelling techniques.
2. Apply ETL processes and OLAP operations for multidimensional data analysis.
3. Preprocess and transform real-world datasets using standard data cleaning methods.
4. Perform association rule mining to discover interesting patterns in datasets.
5. Implement classification and prediction models for dataset.
6. Apply clustering algorithms to identify patterns and clusters in large datasets.

List of Experiments.

Sr. No	Experiment Name	
1.	Design dimensional models (star and snowflake schema)	2
2.	Implement dimension tables and fact tables	2
3.	Simulate ETL process (extract, clean, load) using Python	2
4.	Perform data cleaning: handle missing values, noisy data, and duplicates	2
5.	Apply data integration and transformation on environmental dataset	2
6.	Implement Apriori algorithm to find frequent itemsets	2
7.	Perform FP-Growth algorithm for pattern mining	2
8.	Build and evaluate a Decision Tree classifier	2
9.	Implement Naïve Bayes classifier on weather or health prediction dataset	2
10.	Perform K-Means clustering on air quality index dataset	2

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Sr no.	Assignment	CO
		Mapped
1	Assignment 1: Data Warehouse Design and OLAP Operations 1. Design a Star and Snowflake schema for a real-world application (e.g., Hospital Management or Retail Sales). 2. Compare OLTP vs. OLAP systems with examples and use cases. 3. Explain and implement OLAP operations (Slice, Dice, Roll-up, Drill-down, Pivot) using a sample multidimensional dataset. 4. Justify the use of Fact and Dimension tables in your schema. 5. Discuss the role of ETL in data warehouse architecture and write steps of a basic ETL flow. 6. Compare MOLAP and ROLAP models with suitable examples.	CO1, CO2, CO3
2	Assignment 2: Data Mining Techniques and Applications 1. Define the KDD process and explain how it differs from traditional database querying. 2. Implement the Apriori algorithm on a transactional dataset and interpret the association rules. 3. Use classification techniques (Decision Tree and Naïve Bayes) to predict student performance or weather outcome. 4. Perform data preprocessing tasks on any public dataset (cleaning, integration, reduction, discretization). 5. Compare K-means and Agglomerative clustering with respect to performance and suitability. 6. Evaluate model performance using accuracy, precision, recall for classification models.	CO4, CO5, CO6

Text Books:

1. **Paulraj Ponniah**, “*Data Warehousing: Fundamentals for IT Professionals*”, Wiley India.
2. **Jiawei Han, Micheline Kamber, Jian Pei**, “*Data Mining: Concepts and Techniques*”, Morgan Kaufmann.
3. **Pang-Ning Tan, Michael Steinbach, Vipin Kumar**, “*Introduction to Data Mining*”, Pearson Education.



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References:

1. **William H. Inmon**, “*Building the Data Warehouse*”, Wiley India.
2. **Ralph Kimball**, “*The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling*”, Wiley India.
3. **Max Bramer**, “*Principles of Data Mining*”, Springer.
4. **Manaranjan Pradhan, U. Dinesh Kumar**, “*Machine Learning Using Python*”, Wiley.
5. **Joel Grus**, “*Data Science from Scratch: First Principles with Python*”, O’Reilly Media.

Online Resources:

Sr. No.	Website Name
1.	WEKA Tool and Documentation – https://www.cs.waikato.ac.nz/ml/weka/
2.	Scikit-learn (sklearn) Library – https://scikit-learn.org/stable/
3.	DataCamp – Interactive Python and R Coding – https://www.datacamp.com

Assessment:

Term Work: Term Work shall consist of at least 10 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
ECL609	Skill base Lab: Linux Server Administration Lab	-	4	-	-	2	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT 1	IAT 2	Total				
ECL609	Skill base Lab: Linux Server Administra tion Lab	--	--	--	--	50	—	50

Lab Objectives:

1. To introduce the concept of Open-Source Software.
2. To impart knowledge and skills on various practical and theoretical aspects of Linux operating system (OS) basics.
3. To Study Linux OS based server configuration, management and administration.
4. To provide a comprehensive introduction to SHELL programming, services and utilities.
5. To Introduce Linux System Security.

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6. To Study Virtualization technologies concepts like Hypervisor, emulation, and application

Lab Outcomes:

1. Understand the concept of Open-source technology and basics of Linux operating system.
2. Learn various Linux Command Line administration tasks and perform file, user, group and process management tasks.
3. Learn various Linux Command Line utilities to perform storage and network management tasks.
4. Learn Linux Server administration tasks and configure servers for front and backend services.
5. Analyse a given problem and apply requisite facets of SHELL programming in order to devise a SHELL script to solve the problem.
6. Apply security measures to protect the operating environment and explain virtualization and their role in elastic computing.

Suggested List of Experiments:

1	Installation of Red HAT/Centos/Fedora Linux operating system. Partitioning drives Configuring boot loader (GRUB/LILO) Updating and upgrading the system Shutting down and reboot
2	Learning and executing Linux commands for Interacting with BASH shell and built-in shell variables Navigation File and directory management Working with links Searching files



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3	Learning and executing Linux commands for Process management tasks like Executing a process Getting process info Killing a process Changing process attributes Managing foreground and background processes Scheduling automated jobs using CRON jobs
4	Learning and executing Linux commands for managing Users, Groups, and Permissions . Creating, modifying and deleting users Creating, modifying and deleting groups Managing file permissions, attributes and ownerships Setting Default Permissions with umask Setting up access control list for files and directories
5	Learning and executing Linux commands for managing Storage drives in Linux environment Create partitions Install file system Mount and unmount partitions manually from CLI Automated mounting using fstab Encrypt volumes
6	Learning and executing Linux commands for managing networking in Linux environment Enable networking services from command line Configure IP and other network settings from command line. Configure IP and other network settings from configuration files. Configure SSH based services for CLI and GUI access on remote machines.
7	Install and configure an NFS server and mount NFS shares on Linux Environment.
8	Install and configure files sharing services using FTP server.
9	Install and configure Samba file server and share files across local network.



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10	Install and configure a LAMP stack and deploy a full stack web application on it with SSL/TLS security.
11	Shell Scripting Write a shell script program to display list of user currently logged in. Write a shell script program to display "HELLO WORLD". Write a shell script program to develop a scientific calculator. Write a shell Script program to check whether the given number is even or odd. Shell script Program to search whether element is present is in the list or no Shell script program to check whether given file is a directory or not. Shell script program to count number of files in a Directory. Shell script program to copy contents of one file to another. Create directory, write contents on that and Copy to a suitable location in your home directory. Use a pipeline and command substitution to set the length of a line in file to a variable.
12	Configuring security for the Linux Server environment using SELinux and FirewallD
13	Install and set up KVM to run isolated instances of other operating systems inside a Linux host system

Text Books:

1. Linux: The Complete Reference, Sixth Edition by Richard Petersen, McGraw Hill Education; 6th edition (1 July 2017).
2. Linux Command Line and Shell Scripting Bible by Richard Blum Wiley; 3rd edition (17 March 2015).
3. Red hat Linux Networking and System Administration, by Terry Collings and Kurt Wall, Wiley 3rd edition 2005

References:

1. Linux Administration: A Beginner's Guide by Wale Soyinka, McGraw-Hill Education; 8th edition (28 April 2020).
2. Red Hat Enterprise Linux 6 Administration, Real World Skills for Red Hat Administrators by Sander van Vugt, John Wiley and Sons 2013.
3. Rhcsa Red Hat Enterprise Linux 8: Training and Exam Preparation Guide, Asghar Ghor, Endeavor Technologies (10 January 2020).



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Online Resources:

Sr. No.	Website Name
1.	https://www.virtualbox.org/wiki/Downloads
2.	https://distrotest.net/
3.	https://training.linuxfoundation.org/training/introduction-to-linux/

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: 50 Marks (Total marks) = 30 Marks (Experiment) + 10 Marks (Assignments) + 10 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.		Total
ECL610	Mini Project-2B	-	-	-	-	-	-	2

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECL610	Mini Project-2B	-	-	-	-	-	25	25	50

Rationale :

A mini project provides students with hands-on experience in applying theoretical knowledge to real-world problems. It enhances practical skills, encourages innovation, and strengthens problem-solving and teamwork abilities. Through the mini project, students learn to plan, design, and implement solutions, which prepares them for larger projects, research, or industry challenges in the future.

Course Objectives:

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1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcomes:

1. Identify problems based on societal /research needs.
2. Apply knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results.
5. Analyze the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices.
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life-long learning.
9. Demonstrate project management principles during project work

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for mini projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Major focus of Mini-project 2 shall be towards exploration and applicability of knowledge acquired in the domain areas of DLOs available for the year.
- Students shall give special consideration to identify and provide solutions to the burning societal and/or environmental issues which may affect mankind to a

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larger extent.

- Students shall submit implementation plans in the form of a Gantt/PERT/CPM chart, which will cover weekly activity of the mini project.

A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.

- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self- learning.
- Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/supervisor.
- Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case-to-case basis.

Guidelines for Assessment of Mini Project:

The review/ progress monitoring committee shall be constituted by heads of departments of each institute. The progress of the mini project to be evaluated on a continuous basis, minimum two reviews in each semester. In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.

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Distribution of Term work marks for both semesters shall be as below;

Marks awarded by guide/supervisor based on logbook : 10

Marks awarded by review committee 10

Quality of Project report 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

In the first **semester the entire** theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on the presentation given by the student group.

- First on identification and finalization of problem
- Second on the proposed solution for the problem.

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 shall be based on readiness of building working prototype.
- Second review shall be based on poster presentation-cum-demonstration of working model in the last month of the said semester.

Half-year project:

In this case students' group shall complete project in all aspects, in a semester, including;

- Identification of need/problem
- Proposed acceptable solution for the identified problem
- Procurement of components/systems, if any,
- Building a working prototype and testing

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The group shall be evaluated twice during the semester by review committee, mainly look for the progress as;

- First review focus shall be towards identification & selection of problem and probable solution proposal.
- Second review shall be for implementation and testing of the solution.
(Innovative/out of box solution)

Assessment criteria of Mini Project.

Mini Project shall be assessed based on following criteria:

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Innovativeness and out of box thinking
6. Cost effectiveness and Societal impact
7. Functional working model as per stated requirements
8. Effective use of skill sets acquired through curriculum including DLOs
9. Effective use of standard engineering practices & norms
10. Contribution of an individual as team member/Leader
11. Feasibility to deploy the solution on large scale
12. Clarity in written and oral communication

In a one **year project**, first semester evaluation may be based on the first six criteria and remaining may be used for second semester evaluation of performance of students in



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mini-project. In case of **half year project** all criterias in generic may be considered for performance evaluation of students in mini-project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

Report should be prepared as per the guidelines issued by the University of Mumbai. Mini Projects 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 the Institute.

Students shall be motivated to publish a paper based on the work in Conferences/students competitions. The Mini Project shall be assessed by a team of external & internal examiners at the end of semester/year. Performance shall be evaluated based on;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Implementation of working model
5. Effective use of diversified skill-set
6. Effective use of standard engineering practices & norms
7. Contribution of an individuals as a member/Leader
8. Clarity in written and oral communication



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SEM VII

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC701	VLSI Design	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC701	VLSI Theory	20	20	40	60	2.5	25	25	50

Rationale : The VLSI (Very-Large-Scale Integration) Design course is essential in BE Electronics & Computer Science as it equips students with the knowledge to design and implement integrated circuits used in modern electronic systems. With the rapid advancement of semiconductor technology, understanding VLSI is critical for developing efficient, high-performance, and low-power chips. The course bridges the gap between theoretical electronics and real-world chip design, preparing students for careers in chip design, embedded systems, and semiconductor industries.

Course Objectives:

1. To understand VLSI Design flow and technology trends.

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2. To understand MOSFET based Inverter fundamentals
3. To realize MOS based circuits using different design styles.
4. Understand MOS based combinational/sequential circuits using different design styles.
5. To study semiconductor memories using MOS logic.
6. To study adder, multiplier and shifter circuits for realizing data path design.

Course Outcomes:

After successful completion of the course students will be able to:

1. Demonstrate a clear understanding of VLSI Design flow, technology trends, scaling and MOSFET models.
2. Design and analyse MOS based inverters.
3. Realise MOS based circuits using different design styles.
4. Realise MOS based combinational circuits using different design styles.
5. Realise semiconductor memories using CMOS logic.
6. Realise adder, multiplier and shifter circuits using CMOS logic.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	VLSI Design flow and Technology Trends	VLSI Design Flow: Full custom and Semi Custom IC design flow Semiconductor Manufacturing: Semiconductor technology trend, clean rooms, Wafer cleaning and Gettering. Fabrication flowchart for steps in IC fabrication Scaling: Types of scaling, comparison of MOSFET Model levels Technology Comparison: Comparison of BJT and MOS technologies, long channel and short channel MOS devices	05	CO1

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II	MOSFET Inverters	Introduction to MOS inverters: Active and passive load nMOS inverters, CMOS inverter and their comparison Circuit Analysis of MOS Inverters Static Analysis of Resistive nMOS and CMOS Inverters: Calculation of critical voltages and noise margins Design of symmetric CMOS inverter Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay Various components of power dissipation in CMOS circuits	08	CO2
III	MOS design Styles	Static CMOS, Pseudo NMOS design styles, Pass transistor, Transmission gate, Dynamic, C ² MOS, Significance of Stick diagram and Design rules, Layout of CMOS NAND, CMOS NOR Self learning topics: Design of various gates using software tools.	07	CO3
IV	Combinational and Sequential Circuit Realization	Analysis and design of 2-I/P NAND, 2-I/P NOR and complex Boolean function realization using equivalent CMOS inverter for simultaneous switching, Complex Boolean function realization using various design styles and Basic gates and MUX realization using pass transistor and transmission gate logic SR Latch, JK FF, D FF, 1 Bit Shift Register realization using CMOS logic	07	CO4
V	Semiconductor Memories	SRAM: 6T SRAM operation, design strategy, read/write circuits, sense amplifier, DRAM: 1T1R, operation modes, leakage currents, refresh operation, physical design ROM Array: NAND and NOR based ROM array Flash memory: F-N tunnelling	06	CO5
VI	Data Path Design	Adder: CLA adder, MODL, Manchester carry chain, High-speed adders: carry skip, carry select and carry save Multipliers and shifter: Array multiplier and barrel shifter	06	CO6

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Total		39	

Text Books:

1. CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw Hill, Revised 4th Edition.
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley India Pvt. Ltd.
3. Sorab K. Gandhi, "VLSI Fabrication Principles", Wiley, Student Edition.

Reference Books:

1. Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan, Borivoje Nikolic, Pearson Education, 2nd Edition
2. Basic VLSI Design, Douglas A Pucknell, Kamran Eshraghian, Prentice Hall of India Private Ltd.
3. Logical Effort: Designing Fast CMOS Circuits, Ivan Sutherland and Bob Sproull
4. Basics of CMOS Cell Design, Etienne Sicard and Sonia Delmas Bendhia, Tata McGraw Hill
5. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste, David Harris and Ayan Banerjee, Pearson Education
6. Analysis and Design of Digital Integrated Circuits, David Hodges, Horace Jackson, Resve Saleh, McGraw-Hill, Inc.
7. Advanced Semiconductor Memories: Architectures, Designs, and Applications, Ashok K. Sharma, Wiley Publication

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117106092
2.	https://www.nielit.gov.in/calicut/calicut/content/vlsi-beginners

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC702	Internet of Things	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC702	Internet of Things	20	20	40	60	2.5	--	--	100

Rationale:

The subject "Internet of Things (IoT)" introduces students to smart, connected devices and real-time data exchange. It builds practical skills in sensors, communication, and automation, preparing them for careers in modern tech-driven industries.

Course Objectives:

1. To understand the basic building blocks of IoT
2. To understand various IoT protocols.
3. To introduce data handling in IoT
4. To understand web protocols
5. To design IOT Methodology
6. To understand the Design Methodology in IoT through case studies

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Course Outcomes:

1. Enumerate the layers of OSI model and TCP/IP model and describe their functions.
2. Identify the characteristics of network devices and media used to design networks.
3. Demonstrate the knowledge of networking protocols at various layers of TCP/IP model.
4. Classify the routing protocols and analyse how to assign the IP addresses for a given network
5. Design and configure the networks using IP addressing and sub-netting / super-netting schemes.
6. Explain the functions of Application layer and Presentation layers, their paradigms and

Prerequisite:

- 1) Computer Networks
- 2) Embedded Systems
- 3) Web Technologies

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to IoT	Definition and Characteristics of IoT, IoT Protocols IoT Functional Blocks IoT Communication Models IoT Communication APIs :- REST and WebSockets IoT Enabling Technologies Introduction to M2M and Difference between IoT and M2M	5	CO1

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II	Components (Things) in IoT	Sensor Technology, Examples of Sensors Actuators Applications of RFID and WSN in IoT Exemplary Device: - R-Pi and its Interfaces, PCDuino, BeagleBone	5	CO2
III	Data Handling in IoT	Data Acquiring and Storage, Organizing the Data, Transactions and Business Processes, Analytics Data Collection, Storage and Computing Using Cloud Platform, Introduction to Cloud Computing, Virtualization, Cloud Models Cloud Services IoT Cloud-based Data Collection, Storage, Computing using Xively	9	CO3
IV	Design Principles for Web Connectivity	Communication Technologies – A comparison Web Communication Protocols for connected devices:- CoRE Environment, CoAP, LWM2M, MQTT, XMPP, HTTP, SOAP Protocols LPWAN Fundamentals: LORA and NB-IoT	10	CO4
V	IoT Design Methodology	Defining Specifications About: - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration: - Case Studies of Home automation, Weather Monitoring IoT Levels and Deployment Templates Supply Chain Management	6	CO5
VI	IoT Security and Vulnerabilities Solutions	IoT Security Tomography and Layered Attacker Model Identity Management, Establishment, Access Control and Secure Message Communication	4	CO6

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		Security Protocols	

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-on Approach, University Press.
2. Raj Kamal, “ Internet of Things: Architecture and Design Principles”, McGraw Hill Education ,First edition
3. David Hanes ,Gonzalo salgueiro “IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things”, Cisco Press, Kindle 2017 Edition
4. Andrew Minter ,”Analytics for the Internet of Things(IoT)”, Kindle Edition

References:

- Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things”, Paperback, First Edition
2. Yashavant Kanetkar, Shrirang Korde: Paperback “21 Internet of Things (IOT) Experiments”, BPB Publications

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://nptel.ac.in/courses/106105166



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC731	Deep Learning	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC731	Deep Learning	20	20	40	60	2.5	--	--	100

Rationale

Deep Learning is a specialized branch of Artificial Intelligence and Machine Learning that focuses on training neural networks with multiple layers to learn complex patterns and representations from large amounts of data. The rationale for studying Deep Learning lies in its powerful ability to solve high-dimensional and unstructured problems such as image recognition, natural language processing, speech recognition, and autonomous systems. It forms the backbone of modern AI applications like virtual assistants, self-driving cars, recommendation systems, and medical diagnosis tools. By understanding Deep Learning, students gain essential knowledge and practical skills

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needed to build intelligent systems, innovate across industries, and contribute to cutting-edge research and technological development.

Course Objectives:

1. To develop mathematical concepts required for Deep Learning algorithms.
2. To gain an in-depth understanding of training Deep Neural Networks.
3. To acquire knowledge of advanced concepts of Convolution Neural Networks, Auto encoders and Recurrent Neural Networks.
4. To get familiarized with the recent trends in Deep Learning.

Course Outcomes:

1. Understand the basic knowledge of Neural Networks.
2. Explain the process of training, optimization and Regularization of Deep Neural Networks.
3. Design supervised models for DNN.
4. Design unsupervised model for DNN.
5. Select a suitable DNN model for a given application.

Prerequisite: Knowledge of Basic Electrical Engineering, Basic Electronics, Digital Electronics, Electronics Measurement and Instruments

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning, Delta learning, Multilayer Perceptron: Linearly separable, linearly	05	CO1

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		non-separable classes. Deep Networks: Fundamentals, Brief History, Three Classes of Deep Learning Basic Terminologies of Deep Learning		
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.	06	CO2
III	Convolutional Neural Networks (CNN): Supervised Learning	Convolution Operation, Motivation, Basic structure of a convolutional neural network: Padding, strides, pooling, fully connected layers, interleaving between layers. Training a convolutional network: Backpropagation through convolution, Backpropagation as convolution with inverted filter, Convolution/backpropagation as matrix multiplication.	08	CO3

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		Modern Deep Learning Architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet.		
IV	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	CO4
V	Autoencoders: Unsupervised Learning	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoders. Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders.	08	CO5
VI	Recent Trends and Applications	Generative Adversarial Network (GAN): Architecture. Applications: Image Compression, Brain Tumour Detection, Fraud Detection, Expression identification.	06	CO6
Total			39	

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Li Deng and Dong Yu, "Deep Learning Methods and Applications", now publishers Inc (30 June 2014)
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. J M Zurada "Introduction to Artificial Neural Systems", Jaico Publishing House

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5. M. J. Kochenderfer, Tim A. Wheeler. “Algorithms for Optimization”, MIT Press.

References:

1. Jon Krohn, Grant Beyleveld, Aglae Bassens, “Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence”, Pearson Education.
2. Buduma, N. and Locascio, N., “Fundamentals of deep learning: Designing next-generation machine intelligence algorithms” 2017. O'Reilly Media, Inc.”.
3. François Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Douwe Osinga. “Deep Learning Cookbook”, O'REILLY, SPD Publishers, Delhi.
5. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.

Online References:

Sr. No.	Website Name
1.	https://archive.nptel.ac.in/courses/106/106/106106184/
2.	https://www.machinemetrics.com/blog/industrial-automation
3.	https://www.clarify.io/learn/industrial-automation



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC732	Image Processing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC732	Image Processing	20	20	40	60	2.5	--	--	100

Rationale: The Image Processing course is vital for understanding how to analyze, enhance, and interpret visual information using digital techniques. It lays the foundation for applications in medical imaging, surveillance, robotics, and machine vision. By learning image acquisition, filtering, and feature extraction, students gain practical skills relevant to modern electronics and AI-driven systems.

Course Objectives:

1. To learn the basic concepts of image processing.
2. To learn the fundamental concepts of image processing for image enhancement.
3. To learn concepts of image segmentation & morphology.
4. To learn image compression with practical applications.
5. To learn computer vision basics.
6. To provide basic concepts of computer vision and its applications.

Course Outcomes:

After successful completion of the course students will be able to:

1. Represent image in its numerical and graphical form.

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2. Perform different image enhancement approaches for improving image quality.
3. Elucidate the mathematical modelling of image segmentation and morphology.
4. Apply the concept of image compression.
5. Understand computer vision system elements.
6. Develop a computer vision system based on requirement

Prerequisite: Engineering Mathematics, Digital Signal Processing

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hrs	CO Mapping
I	Fundamentals of Digital Image Processing	Introduction: Background, Representation of a Digital Image, Fundamental steps in Image Processing, Elements of a Digital Image Processing System. Digital Image Fundamentals: Elements of Visual Perception, A Simple Image Model, Two-dimensional Sampling and Quantization, Tonal and Spatial Resolutions, Introduction to ColorModel(RGB, CMYK, YIQ, HSI).	4	CO1
II	Enhancement in Spatial and Frequency domain	Enhancement in the spatial domain: Intensity Transformations, Histogram Processing, Arithmetic and logical operations. Spatial domain filters: Smoothing Filters, Sharpening Filters, High boost Filter. Image Transforms: 2D-DFT, FFT, DCT and Haar Transform. Frequency domain enhancement, Homomorphic filtering.	10	CO2
III	Image Segmentation and Morphology	Image Segmentation: Detection of discontinuities Edge linking and Boundary detection Thresholding, Region based segmentation. Image Morphology: Dilation, Erosion, Opening Closing, Hit-Or-Miss Transformation, Boundary	06	CO3

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		Detection, Thinning, Thickening.		
IV	Image Compression	Need of compression, Redundancy, Objective and subjective fidelity criteria. Lossless compression: Run Length Coding, VLC (Huffman coding), Arithmetic coding, LZW Coding, Vector Quantization. Lossy compression: Bit plane coding, Predictive Coding, Transform Coding, JPEG Compression standard.	6	CO4
V	Computer Vision Basics	Introduction, definition, Computer vision components, Boundary Pre-processing: Chain code, Boundary approximation, Signatures, Skeletonization. Image Feature Extraction: Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, Gabor Filters and DWT. Boundary feature descriptors: Basic descriptors, Shape descriptor, Fourier descriptors, Statistical moments. Region feature descriptors: color, intensity and texture.	9	CO5
VI	Computer Vision applications	Computer Vision applications: Visual inspection of equipments, object detection like locating pedestrians, face detection and recognition, counting vehicles, content-based image retrieval, applications of computer vision in agriculture, health care, industry, sports etc	4	
	Total		39	

Text Books:

1. Rafael C. Gonzalez and Richard E.Woods, "Digital Image Processing," Pearson Education, edition 4, 2018.
2. Anil K.Jain, "Fundamentals of Digital Image Processing," Pearson Education, 2010.
3. S. Jayaraman, T. Veerakumar, A. Esakkirajan, "Digital Image Processing," First Edition, McGraw Hill Education, 2017

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4. Robert J. Schallkoff , “Digital Image Processing and Computer Vision”, John Wiley and Sons, 1989.
5. J. R. Parker , “Algorithms for Image Processing and Computer Vision” John Wiley and Sons, 1997.

Reference Books:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003
2. B.Chanda and D.Dutta Majumder, “Digital Image Processing and Analysis,” Prentice Hall of India, 2002
3. William K. Pratt, “Digital Image Processing,” John Wiley & Sons, 2nd edition, 2004
4. Alan C. Bovik, "Handbook of Image and Video Processing," Elsevier Science Publishing Co Inc, 2009
5. Richard Szeliski, "Computer Vision: Algorithms and Applications," 2nd edition, The University of Washington, 2022
6. Kenneth R. Castleman, "Digital Image Processing," Pearson Education, 2006.



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R-2025- B.E (Sem VII) Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC733	Big Data Analytics	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC733	Big Data Analytics	20	20	40	60	2.5	--	--	100

Rationale :

The syllabus addresses core technologies and architectures used in large-scale data systems, equipping students with practical skills in Hadoop, NoSQL, and data mining techniques.

Course Objectives:

1. Understand the fundamental concepts, architecture, and characteristics of Big Data and its analytics techniques.
2. Explore and work with the Hadoop ecosystem and its tools for large-scale data processing.
3. Learn NoSQL databases, their design patterns, and use cases for managing unstructured and semi-structured data.

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- 4 Understand the MapReduce framework and implement distributed algorithms for Big Data.
5. Apply big data analytics techniques such as similarity detection, stream mining, and graph analysis to solve real-world problems.
6. Analyze application domains such as recommendation systems and social network mining using Big Data tools and concepts.

Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Describe the characteristics, types, and challenges of Big Data, and explain traditional vs big data.
- 2) Demonstrate the architecture and working of the Hadoop ecosystem and its associated tools.
- 3) Use NoSQL database systems to manage and query semi-structured and unstructured data.
- 4) Design and implement data processing algorithms using the MapReduce programming model
- 5) Apply techniques like similarity measures, stream mining, and PageRank for real-world data analytics.
- 6) Evaluate Big Data applications such as recommendation systems and social network analytics.

Prerequisite: Database Management Systems, Basic Data Structures and Algorithms, Programming (Python or Java)

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hou rs	CO Mapping
I	Introducti on to Big Data	Introduction to Big Data, Big Data characteristics, Types of Big Data, Traditional vs. Big Data a business approach,	3	CO1



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	Analytics	Technologies Available for Big Data, Infrastructure for Big Data, Big Data Challenges, Case Study of Big Data Solutions.		
II	Introduction to Big Data Frameworks	Introduction to Hadoop. Core Hadoop Components, Hadoop Ecosystem-Apache HBase, Hive, HCatalog, Pig, Mahout, Oozie, Zookeeper, Sqoop, Physical Architecture, Hadoop limitations.	5	CO2
III	NoSQL	Introduction to NoSQL, NoSQL business drivers, NoSQL database case studies. NoSQL data architecture patterns: Key-value stores, Graph stores, Column family (Bigtable) stores, Document stores, Variations of NoSQL architectural patterns Using NoSQL to manage big data: What is a big data NoSQL solution? Understanding the types of big data problems; Analyzing big data with a shared-nothing architecture; Choosing distribution models: master-slave versus peer-to-peer; Four ways that NoSQL systems handle big data problems, Managing MongoDB database with CRUD operations.	6	CO3
IV	MapReduce Paradigm	MapReduce and The New Software Stack: 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: MapReduce WordCount Program, Matrix-Vector Multiplication by MapReduce ,	6	CO4



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		Relational-Algebra Operations by MapReduce, Matrix Operations, Matrix Multiplication by MapReduce		
V	Techniques in Big Data Analytics	Finding Similar Item: Nearest Neighbor Search, Similarity of Documents, Distance Measures: Euclidean, Jaccard, Cosine, Edit and Hamming Distance with its Examples Mining Data Streams: Data Stream Management Systems, Data Stream Model, Examples of Data Stream Applications: Sensor Networks, Network Traffic Analysis Filtering streams: The Blooms filter. Link Analysis: PageRank Definition, Structure of the web, dead ends, Using Page rank in a search engine, Efficient computation of Page Rank: Page Rank Implementation Using MapReduce Frequent Itemset Mining: Market-Basket Model, Apriori Algorithm, Algorithm of Park- Chen-Yu	13	CO5
VI	Cluster Analysis	Recommendation Systems: Introduction, A Model for Recommendation Systems: Collaborative-Filtering System, Content based system and its Examples. Mining Social-Network Graphs: Social Networks as Graphs, Types of Social-Network. Clustering of Social Graphs: Applying Standard Clustering Techniques, Counting triangles using map	6	CO6
Total			39	

Text Books:



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1. Radha Shankarmani and M Vijayalakshmi —Big Data Analytics, Wiley
2. Alex Holmes —Hadoop in Practice, Manning Press, Dreamtech Press.
3. Dan McCreary and Ann Kelly —Making Sense of NoSQL – A guide for managers and the rest of us, Manning Press.

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

Online References:

Sr. No.	Website Name
1.	https://www.analyticsvidhya.com/blog/2014/05/hadoop-simplified
2.	https://www.analyticsvidhya.com/blog/2014/05/introduction-mapreduce/
3.	https://www.pdfdrive.com/big-data-analytics-a-hands-on-approach-e158549112.html
4.	https://www.pdfdrive.com/data-science-and-big-data-analytics-e58447171.html

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC734	Advanced Database Management Systems	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC734	Advanced Database Management Systems	20	20	40	60	2.5	25	25	150

Rationale :

The Advanced Database Management System subject equips students with in-depth knowledge and practical skills to design, optimize, and manage complex databases for efficient data handling and decision-making

Course Objectives:

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1. To impart knowledge related to query processing and query optimizer phases of a database management system
2. To introduce concepts of advanced access control techniques like role based and discretionary methods
3. To impart knowledge related to indexing in database management system
4. To introduce advanced database models like parallel and distributed databases
5. To impart an overview of emerging data models like temporal, mobile and spatial databases.
6. To introduce concepts of Big data

Course Outcomes:

At the end of the course learner will be able to

1. Measure query costs and design alternate efficient paths for query execution.
2. Apply sophisticated access protocols to control access to the database.
3. Implement alternate models like Parallel and Distributed databases and Design applications using advanced models like mobile, spatial databases
4. Apply indexing techniques on large data in database
5. Apply Big data concepts in real world applications

Prerequisite: Data structure concepts, Discrete structure

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Query Processing and Optimization	Query Optimization Overview, Measures of Query Cost Selection Operation	07	CO1



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		Sorting, Join Operation, Other Operations, Evaluation of Expressions Transformation of Relational Expressions Estimating Statistics of Expression Results, Choice of Evaluation Plans		
II	Advanced Data Management Techniques	Advanced Database Access protocols: Discretionary Access Control Based on Granting and Revoking Privileges; Mandatory Access Control and Role-Based Access Control. Overview of Advanced Database models like Mobile databases, Temporal databases, Spatial databases.	06	CO2
III	Indexing	Indexed Sequential Access Method (ISAM) B+ Trees: A Dynamic Index Structure, Format of a Node Search, insert, delete operations in B+ Tree Hashing Techniques; Types of Indexes: Single Level Ordered Indexes; Multilevel Indexes; Overview of B-Trees and B+-Trees	06	CO3
IV	Parallel Databases	Architectures for Parallel Databases, Parallel Query Evaluation and Optimization Data Partitioning, Parallelizing Sequential Operator Evaluation Code Parallelizing Individual Operations: Bulk Loading and Scanning, sorting, joins	08	CO4

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V	Distributed Databases	Introduction: Distributed Data Processing, What is a Distributed Database System Design Issues, Distributed DBMS Architecture. Distributed Database Design: Top-Down Design Process, Distribution Design Issues, Fragmentation, Allocation. Overview of Query Processing: Query Processing Problem, Objectives of Query Processing Characterization of Query Processors, Layers of Query Processing, Query Optimization in Distributed Databases;	06	CO5
VI	Introduction to Big Data	Sources and Uses of Big Data, Querying Big Data Big Data Storage Systems: Distributed File Systems, Key-Value Storage Systems The MapReduce Paradigm: MapReduce in Hadoop with the example of word count Streaming Data: Querying Streaming Data Introduction to Graph Databases	06	CO5
Total			39	

DETAILED SYLLABUS:

Text Books:

1. Korth, Sliberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON .

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3.Raghu Ramakrishnan and Johannes Gehrke, “Database Management Systems” 3rd Edition McGraw Hill

References:

1. Hector Garcia-Molina, Jeffrey D. Ullman, Jennifer Widom “Database System Implementation”, Pearson Ltd. 1/e
2. Thomas M. Connolly Carolyn Begg, Database Systems: A Practical Approach to Design Implementation and Management, 4/e, Pearson Ltd.

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106095
2.	https://www.scaler.com/topics/course/dbms/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC741	Cloud Computing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Avg.					
ECC741	Cloud Computing	20	20	40	60	2.5	--	--	100

Rationale : Cloud computing offers numerous benefits, including cost reduction, increased flexibility and scalability, enhanced security, and improved collaboration, making it a vital subject for students and professionals alike.

Course Objectives: Six Course Objectives

1. To provide an overview of cloud computing fundamentals.
2. To make students familiar with the key concepts of virtualization.
3. To explore various cloud computing services.
4. To create an open source cloud.
5. To identify risks and provide cloud security.
6. To analyze several cloud applications and recent trends in cloud computing.

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Course Outcomes: Six Course outcomes

After successful completion of the course students will be able to:

1. Define cloud computing and understand different cloud services and deployment models.
2. Implement different types of virtualization.
3. Use several cloud computing services.
4. Design of open source cloud.
5. Identification of threats and cloud-based risks for cloud security.
6. Understand cloud applications and recent trends.

Prerequisite: Computer networks, Basics of operating system (O.S.)

Sr. No.	Name of Module	Detailed Content	Hou rs	CO Mappi ng
I	Introduction to Cloud Computing	Definition of cloud computing and cloud data centre, NIST model and cloud cube model, and characteristics of cloud computing. Cloud deployment models (private, public, hybrid, and community) and service models (SaaS, PaaS, and IaaS). Impact of cloud computing on business, key drivers for cloud computing. Advantages and disadvantages of cloud computing.	04	CO1



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II	Virtualization	Introduction and benefits of virtualization, implementation levels of virtualization, VMM. Virtualization at O.S.level, middleware support for virtualization, virtualization structure/tools and mechanisms, hypervisor and xen architecture, binary translation with full virtualization, para virtualization with compiler support. CPU virtualization, memory virtualization and I/O virtualization, virtualization in multicore processors,demonstration of virtualization usingtype II hypervisor.	08	CO2
III	Cloud Computing Services	Exploring different cloud computing services: Software-as-a-Service (SaaS) (e.g.,Dropbox, Google Workspace, Salesforce, etc.), Platform as a Service(PaaS) (e.g., AWS Elastic Beanstalk, Windows Azure, Heroku, Google App Engine, etc.), Infrastructure-as-a-Service (IaaS) (e.g., DigitalOcean, AWS, Microsoft Azure, Google Compute Engine (GCE), etc.). Anything as a Service or Everything as a Service (XaaS), Security as a Service,Identity Management-as-a-Service, and Database as a Service. Storage as a Service,Collaboration as a Service,Compliance as Service,Monitoring as a Service,Communication as a Service, Network as a Service,DisasterRecovery as a Service,Analytics as a Service, and Backup as a Service	05	CO3
IV	Open Source Cloud Implementati	OpenStack Cloud Architecture, Features of OpenStack, Components of OpenStack, Mode of Operations of OpenStack	07	CO4

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	on of OpenStack and Eucalyptus	Eucalyptus Architecture, Features of Eucalyptus, Components of Eucalyptus, Mode of Operations of Eucalyptus Installation and configuration process of OpenStack and Eucalyptus		
V	Cloud Security	Security overview, cloud security challenges and risks, SaaS security, cloud computing security architecture, architectural considerations. General issues in securing cloud, securing data, application, and virtual machine security. AAA model, automatic security establishing trusted cloud computing, secure execution environments and communications, access control, disaster recovery in clouds.	07	CO5
VI	Cloud Applications and Recent Trends	Cloud Applications: Scientific Applications: Healthcare: ECG analysis in cloud IoT-enabled Cloud Applications: Smart Agriculture Business and Consumer Applications: CRM and ERP, Productivity, networking, media applications, multiplayer online gaming. Recent Trends: Mobile cloud computing, autonomic cloud computing, multimedia cloud, energy aware cloud computing.	06	CO6

Text Books:

- 1) Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education
- 2) Cloud Computing and Services by Arup Vithal, Bhushan Jadhav, StarEdu Solutions, SYBGEN Learning India Pvt. Ltd.
- 3) Cloud Computing: A Practical Approach for Learning and Implementation by A. Srinivasan, J. Suresh, Pearson.
- 4) Cloud Security: A Comprehensive Guide to Secure Cloud Computing by Ronald L. Krutz, Russell Dean Vines, Wiley & Sons.
- 5) Cloud Computing Bible by Barrie Sosinsky, Wiley Publishing.

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Text Books:

- 1) Cloud Computing Black Book by Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Deven Shah, Dreamtech Press.
- 2) Amazon Web Services in Action by Michael Wittig, Andreas Wittig, Manning Publisher.

References Book:

- 3) To the cloud: cloud powering an Enterprise, Arora Pankaj, Tata Mc Graw Hill Education.
- 4) Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Kai Hwang, Morgan Kaufmann.

Online References:

Sr. No.	Website Name
1.	NPTEL: https://onlinecourses.nptel.ac.in/noc22_cs20/preview
2.	OpenStack Installation Guide: https://docs.openstack.org/install-guide/ 3) Eucalyptus Installation:
3.	AWS Management Console: https://aws.amazon.com/console/



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC742	Mobile Communication	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC742	Mobile Communication	20	20	40	60	2.5	--	--	100

Rationale:

The Mobile Communication course provides foundational knowledge of wireless communication principles, cellular network architecture, and mobility management. It equips students with the skills to understand, analyze, and design mobile systems used in modern communication technologies. With the rapid growth of mobile networks like 4G, 5G, and beyond, this course is essential for careers in telecommunications, embedded systems, and IoT.

Course Objectives:

1. To understand the fundamentals of cellular communication systems, including

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propagation mechanisms, frequency reuse, and mobility management.

2. To study cellular system design parameters such as cluster size, interference, call setup, handoff strategies, and traffic theory.
3. To explore multiple access and spread spectrum techniques, including TDMA, FDMA, CDMA, and OFDMA used in mobile systems.
4. To analyze 2G to 5G mobile technologies, including GSM, IS-95, GPRS, EDGE, UMTS, LTE, and emerging 5G concepts.
5. To examine the mobile network and transport layer protocols, such as Mobile IP, mobility management, Mobile TCP, and related optimization techniques.
6. To understand application-level mobile communication protocols, including WAP architecture and associated services and standards..

Course Outcomes:

After successful completion of the course students will be able to:

1. Describe the principles of cellular communication systems and explain key concepts such as frequency reuse, handoff strategies, and interference management.
2. Analyze various multiple access techniques including FDMA, TDMA, CDMA, and their role in mobile networks.
3. Compare the architectures, features, and functioning of different generations of mobile communication systems from 2G to 5G.
4. Illustrate the architecture and working of Mobile IP and mobility management protocols in wireless networks.
5. Evaluate the performance of transport layer protocols like Mobile TCP and assess improvements for mobile environments.
6. Explain the structure and components of WAP and mobile application protocols and their role in mobile internet access.

Course Pre-requisite:

1. Analog and Digital Communication
2. Communication Networks
3. Digital Electronics

DETAILED SYLLABUS:



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Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Concept of Cellular Communication	Introduction to cellular communications, basic propagation mechanisms and multipath fading Cellular System design fundamentals: Cluster, frequency reuse, Call setup, Handoff strategies, interference and system capacity, cluster size and system capacity and Channel assignment strategies Traffic Theory: Trunking and Grade of service, Improving Coverage and capacity	7	CO1
II	Multiple Access Techniques	Multiplexing and Multiple Access: Time Division Multiple Access, Frequency Division Multiple Access, Space division multiple access technique Spread spectrum Multiple Access: Need for and concept of spread spectrum (SS) modulation, PN-sequence generation, properties of PN-sequence, Gold sequence generation, Direct-sequence SS, Frequency-hopping SS	6	CO2
III	2-G Technologies	GSM: Services and features, GSM air specifications, GSM network architecture, Physical and Logical Channels, Frame structure, Identifiers, Authentication and security, call procedure, Hand-off procedure IS-95 (CDMA): Air specifications of IS-95, Forward and Reverse CDMA	10	CO3

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		channels, Forward and Reverse CDMA channel modulation process block diagram, power control subchannel, Handoffs in IS 95 CDMA and RAKE receiver. GPRS, EDGE technologies, W-CDMA (UMTS), CDMA2000: features and network architectures LTE: 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 5G		
IV	Evolution from 2G to 5G	GPRS, EDGE technologies, W-CDMA (UMTS), CDMA2000: features and network architectures LTE: 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 5G	6	CO4
V	Mobile Network Layer	Mobile IP: IP Packet Delivery, Agent Advertisement and discovery, Registration, Tunneling and Encapsulation Mobility Management: Introduction, IP Mobility, Optimization, IPv6, Micro Mobility: CellularIP	5	CO5
VI	Mobile Transport and Application Layer	Mobile TCP: Traditional TCP, Classical TCP Improvements like Indirect TCP, Snooping TCP & Mobile TCP, Selective Retransmission WAP: Architecture, WDP, WTLS, WTP, WSP, WAE, WML	4	CO6

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		Total	39	

Text Books:

1. Theodore Rappaport, “Wireless Communications: Principles and Practice, 2nd Edition, Pearson Publication
2. Jochen Schiller, “Mobile Communications”, 3e, Pearson Publication.
3. William Stallings, “Wireless Communication and Networking”, PHI Publication.
4. Vijay Garg, “IS-95 CDMA and CDMA 2000: Cellular/PCS System Implementation”, Pearson Publication.

Reference Books:

1. T.L Singal, “Wireless Communication”, Tata McGraw Hill ,2010.
2. Upena Dalal, “Wireless Communication”, Oxford University Press, 2009.
3. Andreas F Molisch, "Wireless Communication", John Wiley, India 2006.
4. Vijay Garg, “Wireless communication and Networking”, Pearson Publication.
5. Christopher Cox, “An Introduction to LTE: LTE, LTE-Advanced, SAE and 4G Mobile Communications”, Wiley publications.

Online References:

Sr. No.	Website Name
1.	https://www.udemy.com/course/5g-4g-lte-3g-2g-cellular-mobile-communications-wireless
2.	https://www.coursera.org/learn/wireless-communications



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC743	Cyber Security	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC743	Cyber Security	20	20	40	60	2.5	--	--	100

Rationale

This Cyber Security and Laws emphasizes the importance of taking daily actions to reduce online risks and stay safe when using connected devices. It aligns with the goal of raising cybersecurity awareness and promoting proactive security practices.

Objectives:

1. To understand and identify different types of cybercrime and cyber law.
2. To recognize Indian IT Act 2008 and its latest amendments.
3. To learn various types of security standards compliances.
4. To understand Information Security Standards compliance during software design and development.
5. To Interpret and apply IT law in various legal issues.
6. To Interpret Penalties, Adjudication and Appeals Under the IT Act.

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Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development.
5. To Interpret Penalties, Adjudication and Appeals Under the IT Act and Web and Network Security
6. Understand the Information Security Standard compliances.

Prerequisite: Knowledge of Basic Computer Network.

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.	05	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	06	CO2



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		for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops		
III	Tools and Methods Used in Cybercrime	Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Overflow. Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft) Banner Grabbing Techniques, ransom wares, Crypto wares	08	CO3
IV	The Concept of Cyberspace	Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking E-Commerce, The Contract Aspects in Cyber Law, The Security Aspect of Cyber Law The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law, The Criminal Aspect in Cyber Law, Global Trends in Cyber Law, Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking, The Need for an Indian Cyber Law	8	CO4
V	Indian IT Act and Web and Network Security	Cyber Crime and Criminal Justice : Penalties, Adjudication Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments. Web Security: OWASP, Web Security Considerations, Management, Cookies, Privacy on Web, Web Browser Attacks, Web Bugs, Clickjacking, Session Hijacking and Management, Phishing and Pharming Techniques, Web Service Security	08	CO5
VI	Information Security Standard	Role of AI/ML in Cyber Security SOX, GLBA, HIPAA	06	CO6

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	compliances	ISO, FISMA, NERC, PCI.		
Total			39	

Text Books:

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

References Book:

1. William Stallings, *Cryptography and Network Security*, Pearson Publication
2. Nina Godbole, *Information Systems Security*, Wiley India, New Delhi
3. Kenneth J. Knapp, *Cyber Security & Global Information Assurance* Information Science Publishing.

Online Reference

Sr. No.	Website Name
1.	Websites for more information is available on :The Information Technology ACT, 2008- TIFR : https://www.tifrh.res.in
2.	Website for more information , A Compliance Primer for IT professional



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC744	Block Chain Technologies	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT1	IAT2	Total					
ECC744	Block Chain Technologies	20	20	40	60	2.5	--	--	100

Rationale : Blockchain technology offers a decentralized, secure, and transparent method of recording digital transactions, enabling trustless peer-to-peer interactions and revolutionizing sectors such as finance, supply chain, healthcare, and governance by ensuring data integrity and reducing dependency on centralized authorities.

Course Objectives:

1. To learn the fundamentals of Blockchain
2. To obtain knowledge about technologies of Blockchain

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3. To incorporate the models of Blockchain- Ethereum
4. To learn the models of Hyperledger Fabric
5. To explore various applications of Blockchain.

Course Outcomes:

At the end of the course learner will be able to

1. Describe the primitives of the cryptography related to blockchain.
2. Understand and explore the working of Blockchain technology
3. Illustrate the concepts of Bitcoin and their usage.
4. Implement Ethereum block chain contract.
5. Explore Hyperledger Fabric and its working.
6. Investigate security features in blockchain technologies

Prerequisite: Computer Network, Operating System, Cryptography

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction of Cryptography	1.Basic Cryptographic primitives used in Blockchain - Public Key cryptosystem, Cryptographic Hash functions: Properties of Hash, MD5, SHA 256, Hash Pointers and Data Structures, Digital Signatures: ECDSA, Public Keys as Identities, Cryptocurrencies: Goofycoin	07	CO1



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II	Introduction to Blockchain	Centralization vs. Decentralization, What is Blockchain, History of Blockchain, Blockchain defined- peer to peer, Distributed Ledger, Cryptographically Secure, Append-only, Updatable via consensus, How Blockchain Works, Benefits and Limitations of Blockchain, Types of Blockchain, The Structure of a Block, Blockheader, Genesis block, Mining, Rewards, Consensus, Types of Consensus Mechanisms, Consensus in Blockchain.	06	CO2
III	Bitcoin and Cryptocurrency	What is Bitcoin, Private keys in Bitcoin, Public Keys in Bitcoin, Addresses in Bitcoin, Transactions, The Bitcoin Network, Bitcoin Wallets, Scripting language in Bitcoin, Bitcoin Mining- task of Bitcoin miners, Mining Hardware, Crypto Currencies, Anonymity and Pseudonymity in Bitcoin study Alt coins	06	CO3
IV	Introduction to Ethereum	Ethereum blockchain platform, explaining its structure, the Ethereum Virtual Machine (EVM), and how smart contracts enable decentralized application. Introduction to Ethereum, Ethereum's Consensus Mechanisms, MetaMask Setup, Ethereum Accounts, Ethers, Gas, Introduction to Smart Contracts, Remix IDE, Writing smart contracts using Solidity Self Study- Geth, Ganache-Creating Wallets	08	CO4
V	Introduction to Hyperledger	What is Hyperledger? Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer, Transaction Flow Case Study of Supply Chain Management using Hyperledger	06	CO5

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VI	Privacy, Security issues in Blockchain	Pseudo-anonymity vs. anonymity, Zcash and Zk-SNARKS for anonymity preservation, attacks on Blockchains (Sybil attacks, selfish mining, 51% attacks), prevention of attacks Self Study: Corda, Ripple, Quorum platforms and its security	06	CO6
Total			39	

Text Books:

1. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
2. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained”, Second Edition, Packt Publishing, 2018.

References:

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, by Andreas M Antonopoulos 2018
2. D. Drescher, Blockchain Basics. Apress, 2017.
3. Merunas Grinčelaitis, “Mastering Ethereum: Implement Advanced Blockchain Applications Using Ethereum-supported Tools, Services, and Protocols”, Packt Publishing.
4. Blockchain with Hyperledger Fabric, Luc Desrosiers, Nitin Gaur, Salman A. Baset, Venkatraman Ramakrishna, Packt Publishing.



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Online References:

Sr. No.	Website Name
1.	http://www.coursera.org/learn/ibm-blockchain-essentials-for-developers
2.	https://www.nptel.ac.in/courses/106105184/
3.	https://www.tutorialspoint.com/blockchain/index.htm

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL706	VLSI Design Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL706	VLSI Design Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To familiarize students with the complete VLSI design cycle, from specification to layout and verification.
2. To develop practical skills using industry-standard EDA tools for simulation, synthesis, and layout design (e.g., Cadence, Synopsys, Mentor Graphics).
3. To design combinational and sequential digital circuits using CADD tools
4. To gain insight into layout design including design rule checks (DRC)
5. To learn debugging strategies and verify digital designs for functional correctness and performance.
6. To motivate students to design and demonstrate real-time digital systems through project-based learning.

Lab Outcomes:

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By the end of this course, students will be able to:

1. Describe the VLSI design flow and its associated tools. Demonstrate understanding of various stages of VLSI design including specification, synthesis, simulation, and layout.
2. Write and simulate Inverter based digital designs using CAD tools
3. Develop and test combinational and sequential circuits using hardware description languages/Simulation tools.
4. Perform synthesis and analyze timing constraints of digital circuits such as Adders, Subtractors Multipliers etc
5. Design layouts and verify them using DRC and LVS tools.
6. Demonstrate the ability to work on VLSI-based mini projects. Integrate various components of VLSI design to solve practical engineering problems.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Plot Transfer and output characteristics of NMOS /COMS Inverter	2
02	Design CMOS inverter. Carry out static as well as transient simulation with different aspect ratio of pull up and pull-down devices	2
03	Find the equivalent CMOS inverter for the given 2-input NAND and NOR gates	2
04	Implement the given equation using various logic design styles.	2
05	Design and Simulate 4:1 multiplexer using NMOS pass transistor.	2
06	Implement different gates and various logic design styles.	2
07	Implement SR latch using CMOS inverter	2
08	Implement JK FlipFlop I using CMOS inverter	2
09	Implement 6-T SRAM cell using static CMOS logic	2
10	Implement Half adder/full adder cell using any design style	2

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11	Small project (groupwise)	2
12	Case Study (group wise)	2

Sr No	List of Assignments / Tutorials	Hrs
01	Write report on technological advancements in VLSI field since 2020	2
02	Solve given equations using boolean algebra and implement same using various design styles	2

Text Books:

1. CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw Hill, Revised 4th Edition.
2. Introduction to VLSI Circuits and Systems, John P. Uyemura, Wiley India Pvt. Ltd.
3. Sorab K. Gandhi, "VLSI Fabrication Principles", Wiley, Student Edition.

Reference Books:

1. Digital Integrated Circuits: A Design Perspective, Jan M. Rabaey, Anantha Chandrakasan Borivoje Nikolic, Pearson Education, 2nd Edition
2. Basic VLSI Design, Douglas A Pucknell, Kamran Eshraghian, Prentice Hall of India Private Ltd.
3. Logical Effort: Designing Fast CMOS Circuits, Ivan Sutherland and Bob Sproull
4. Basics of CMOS Cell Design, Etienne Sicard and Sonia Delmas Bendhia, Tata McGraw Hill
5. CMOS VLSI Design: A Circuits and Systems Perspective, Neil H. E. Weste, David Harris and Ayan Banerjee, Pearson Education
6. Analysis and Design of Digital Integrated Circuits, David Hodges, Horace Jackson, Resve Saleh, McGraw-Hill, Inc.

Online Resources:



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Sr. No.	Website Name
1.	https://cse14-iiith.vlabs.ac.in/
2.	https://vlsiresources.com/opensourcevlsi/
3	https://vlsi-iitg.vlabs.ac.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)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL707	Internet of Things Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract./ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT 2	Total				
ECL707	Internet of Things Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To develop the ability to interface a variety of sensors with IoT devices and transmit real-time data to cloud platforms for monitoring and analysis.
2. To demonstrate competency in remotely controlling devices using mobile-based applications such as the Blynk App and flow-based development tools like Node-RED.
3. To explore and implement IoT communication protocols (such as MQTT, HTTP, CoAP) for enabling seamless and secure remote device control.
4. To integrate third-party IoT services like Google Assistant, Adafruit IO, IFTTT, and Firebase for smart automation and enhanced functionality.
5. To configure and utilize Amazon Web Services (AWS) for deploying scalable and reliable IoT applications, including cloud storage, processing, and analytics.

Lab Outcomes:

By the end of this course, students will be able to:

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1. Interface various sensors to any IoT device and push data onto the cloud.
2. Remotely control various devices using Blynk App and Node-red environment.
3. Implement IoT protocols to control devices remotely.
4. Implement services like Google Assistance, Adafruit I/O, IFTTT, Firebase etc in IoT.
5. Configure AWS Cloud and its Application in IoT
6. Publish sensor data to IOT cloud.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Interfacing Various Sensors like LDR, ultrasonic, DHT etc (data collection) and pushing data on to Thinkspeak cloud	2
02	Controlling IoT devices/sensors remotely using Node-red and rpi.	2
03	Application of MQTT in node red	2
04	Control a LED Remotely & Monitor Temperature values with a Raspberry Pi using Node-RED	2
05	Controlling IoT devices using Blynk App.	2
06	Temperature and Humidity monitor using Blynk	2
07	ESP8266 Voice Control with Google Assistant and Adafruit IO and IFTTT.	2
08	Implementing Publish-Subscribe model using MQTT protocol and DHT11 sensor	2
09	Google Firebase: - controlling LED using Android App	2
10	Publishing sensor data from ESP32 to AWS IoT Cloud.	2
11	Device controlling over cloud on android mobile app :- Monitoring sensor and different data on mobile phone	2
12	Creating an emergency push button to upload status on Facebook	2
13	To send Push notification to IoT device (R-pi to smart phone)	2
14	Google Assistant Controlled Switch Using NodeMCU	2
15	AWS and SNS service	2

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Sr No	List of Assignments / Tutorials	Hrs
01	Case study of home automation	2
02	Case study of Weather Monitoring	2

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach, Universities Press.
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", McGraw Hill Education, First edition

Reference Books:

1. Adrian McEwen, Hakim Cassimally, : Designing the Internet of Things", Paperback, First Edition
2. Yashavant Kanetkar, Shrirang Korde: Paperback "21 Internet of Things (IOT) Experiments", BPB Publications.

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs53/preview
2.	https://archive.nptel.ac.in/courses/106/105/106105166/

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
ECL781	Deep Learning lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Pract./ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL781	Deep Learning lab	--	--	--	--	25	25	50

Lab Objectives:

1. Implement basic neural network models to learn logic functions.
2. Design and train feed-forward neural networks using various learning algorithms.
3. Build and train deep learning models such as Auto-encoders, CNNs, RNN, LSTM etc.

Lab Outcomes:

By the end of this course, students will be able to:

1. To explore python libraries for deep learning e.g. Theano, TensorFlow etc (Apply)
2. Implement Perceptron algorithm to simulate any logic gate. (Analyze)
3. Implement a back-propagation algorithm to train a DNN with at least 2 hidden layers. (Create)
4. Design and implement a CNN model for digit recognition application. (Evaluate)

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5. Design the architecture and implement the auto-encoder model for Image Compression.(Apply, Analyze)
6. Design and implement GRU for Text / Image / Audio / Video / etc.(Create, Evaluate)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Based on Module 1 (Any two) using Virtual Lab Implement Mc-Culloch Pitts model for binary logic functions. Implement Perceptron algorithm to simulate any logic gate. Implement Multilayer Perceptron algorithm to simulate XOR gate. To explore python libraries for deep learning e.g. Theano, TensorFlow etc	2
02	Module 2 (Any Two) Apply any of the following learning algorithms to learn the parameters of the supervised single layer feed-forward neural network. a. Stochastic Gradient Descent b. Mini Batch Gradient Descent c. Momentum GD d. Nestorev GD e. Adagrad GD	2
03	Module 3 (Any One) Implement a back-propagation algorithm to train a DNN with at least 2 hidden layers. Design and implement a fully connected deep neural network with at least 2 hidden layers for a classification application. Use appropriate Learning Algorithm, output function and loss function.	2
04	Module 4 (Any One) Design and implement a CNN model for digit recognition application. Design and implement a CNN model for image classification.	2
05	Module 5 (Any One)	2

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	Design the architecture and implement the auto-encoder model for Image Compression. Design the architecture and implement the auto-encoder model for Image denoising.	
06	Module 6 (Any One) Design and implement LSTM for Text / Image / Audio / Video / etc. Design and implement GRU for Text / Image / Audio / Video / etc. Design and implement RNN for Text / Image / Audio / Video / etc.	2

Text Books:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville. Deep Learning. An MIT Press book. 2016.
2. Li Deng and Dong Yu, "Deep Learning Methods and Applications", now publishers Inc (30 June 2014)
3. Satish Kumar "Neural Networks A Classroom Approach" Tata McGraw-Hill.
4. J M Zurada "Introduction to Artificial Neural Systems", Jaico Publishing House
5. M. J. Kochenderfer, Tim A. Wheeler. "Algorithms for Optimization", MIT Press.

References:

1. Jon Krohn, Grant Beyleveld, Aglae Bassens, "Deep Learning Illustrated: A Visual, Interactive Guide to Artificial Intelligence", Pearson Education.
2. Buduma, N. and Locascio, N., "Fundamentals of deep learning: Designing next-generation machine intelligence algorithms" 2017. O'Reilly Media, Inc."
3. François Chollet, "Deep Learning with Python", Manning Publications, 2018.
4. Douwe Osinga. "Deep Learning Cookbook", O'REILLY, SPD Publishers, Delhi.
5. Simon Haykin, Neural Network- A Comprehensive Foundation- Prentice Hall International, Inc.

Online Resources:

Sr. No.	Website Name



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1.	https://nptel.ac.https://deeplearning.cs.cmu.edu/S21/index.html 2
2.	http://www.cse.iitm.ac.in/~miteshk/CS6910.html 3
3.	https://nptel.ac.in/courses/106/106/106106184/ 4 https://www.deeplearningbook.org/ 5
4.	http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

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
ECC782	Image Processing Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECC782	Image Processing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Understand the Fundamentals of Digital Image Processing
2. Implement Image Transformation Techniques
3. Perform Image Segmentation and Feature Extraction
4. Develop Skills in Image Restoration and Compression
5. Use Image Processing Tools and Libraries
6. Design and Test Mini-Projects for Real-Time Applications

Laboratory Outcomes:

After successful completion of the laboratory, students will be able to:

- 1) Enhance the quality of images using spatial and frequency domain techniques.
- 2) Apply lossless and lossy compression techniques to reduce image size efficiently.
- 3) Segment image components based on discontinuity and similarity criteria.
- 4) Extract meaningful features from images for specific computer vision

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applications.

- 5) Perform image representation and description for object recognition tasks.
- 6) Implement image analysis algorithms for solving real-time visual problems.

List of Experiments:

Sr.No.	Experiment Name	Hrs
1	Gray level transformation: Negative, Log, Power law, gray level slicing, Contrast stretching.	2
2	Histogram Equalization.	2
3	Neighborhood Processing.	2
4	Filtering in Frequency domain - Smoothing and sharpening.	2
5	2D-DFT and DCT spectrum analysis.	2
6	Compression using Transform Coding (JPEG Baseline coding) with parameter evaluation (CR, MSE, PSNR etc.).	2
7	Morphological Operations: erosion, dilation, opening, closing, boundary detection	2
8	Segmentation based on discontinuity and similarity.	2
9	Use of transforms for face recognition.	2
10	Object detection using statistical moments.	2
11	CBIR using color, shape and texture (as an application).	2
12	Feature Extraction using HOG.	2

Text Books:

1. Rafael C. Gonzalez and Richard E.Woods, "Digital Image Processing," Pearson Education, edition 4, 2018.
2. Anil K.Jain, "Fundamentals of Digital Image Processing," Pearson Education, 2010.
3. S. Jayaraman, T. Veerakumar, A. Esakkirajan, "Digital Image Processing," First Edition, McGraw Hill Education, 2017
4. Robert J. Schallkoff , "Digital Image Processing and Computer Vision", John Wiley

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and Sons, 1989.

5. J. R. Parker, "Algorithms for Image Processing and Computer Vision" John Wiley and Sons, 1997.

Reference Books:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003
2. B.Chanda and D.Dutta Majumder, "Digital Image Processing and Analysis," Prentice Hall of India, 2002
3. William K. Pratt, "Digital Image Processing," John Wiley & Sons, 2nd edition, 2004
4. Alan C. Bovik, "Handbook of Image and Video Processing," Elsevier Science Publishing Co Inc, 2009
5. Richard Szeliski, "Computer Vision: Algorithms and Applications," 2nd edition, The University of Washington, 2022
6. Kenneth R. Castleman, "Digital Image Processing," Pearson Education, 2006.

Online Resources:

Sr. No.	Website Name
1.	https:// https://cse19-iiith.vlabs.ac.in/
2.	https://www.ee.iitb.ac.in/~viplab/
3	https://www.mathworks.com/products/image-processing.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
ECC783	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	Avg. of 2 Tests				
ECC783	Big Data Analytics Lab	--	--	--	--	25	25	50

Rational:

The Big Data Analytics Lab provides practical skills in handling, processing, and analyzing massive datasets using tools like Hadoop, Spark, and Python. It enables students to apply data analytics techniques for real-time insights and decision-making. This lab prepares learners for industry roles in data science, analytics, and intelligent systems.

Lab Objectives:

1. Understand and install the Hadoop ecosystem and related big data tools.
2. Implement basic data operations on HDFS, Hive, and NoSQL databases.
3. Develop MapReduce programs for data analytics.
4. Perform big data processing using stream mining and similarity analysis.

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5. Analyze and visualize social network and recommendation system data.
6. Solve real-time big data problems using case-based experiments.

Lab Outcomes:

On successful completion of the course learner will be able to:

1. Install and configure a Hadoop environment; demonstrate basic file operations in HDFS to understand distributed storage mechanisms.
2. Construct Hive tables and execute HiveQL queries; analyze unstructured data using Pig scripts.
3. Perform CRUD operations in MongoDB; apply key-value, document-store, and column-family NoSQL models to sample data.
4. Design, develop, and execute MapReduce programs for WordCount, matrix operations, and relational algebra queries.
5. Calculate similarity measures (Cosine, Jaccard, Hamming); simulate Bloom filters and implement PageRank using MapReduce.
6. Build a collaborative filtering recommendation system and apply clustering techniques on a social network graph.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Install and configure Hadoop in pseudo-distributed mode.	2
02	Perform HDFS file operations: upload, retrieve, delete, and list files.	2
03	Execute HiveQL queries for table creation, loading data, and querying large datasets.	2
04	Import/export data using Sqoop between MySQL and HDFS.	2
05	Install MongoDB and perform CRUD operations on structured and unstructured datasets.	2
06	Design and execute queries using document and column-store NoSQL patterns.	2
07	Write a WordCount program using MapReduce in Python.	2



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08	Simulate relational operations (JOIN, SELECT) using MapReduce.	2
09	Calculate document similarity using Cosine, Jaccard, and Hamming distances.	2
10	Build a simple recommendation system using collaborative filtering.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Assignment 1: Big Data Concepts and Hadoop Ecosystem(CO1, Co2, CO6) 1. Define Big Data. Explain the five V's (Volume, Velocity, Variety, Veracity, and Value) with real-world examples. 2. Compare traditional RDBMS systems and Big Data systems from a business and technical perspective. 3. Describe the architecture of Hadoop. Illustrate the roles of HDFS and YARN. 4. Explain any three tools from the Hadoop ecosystem (Hive, Pig, HBase, Sqoop, Oozie, etc.) with examples. 5. Discuss one real-life case study of Big Data implementation in sectors such as retail, healthcare, or governance.	4
02	Assignment 2: Big Data Algorithms and Applications 1. Implement the WordCount problem using the MapReduce paradigm (pseudo code or real code in Python/Java). 2. Calculate the Jaccard and Cosine similarity between two short text documents. 3. Explain the concept of Bloom Filter and write a simulation for detecting duplicates in a data stream. 4. Briefly describe the working of the PageRank algorithm and its use in ranking web pages. 5. Design a basic content-based or collaborative filtering recommendation model (explain with steps or pseudocode).	4

Text Books:

1. Seema Acharya & Subhashini Chellappan – Big Data and Analytics, Wiley India.

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2. Tom White – Hadoop: The Definitive Guide, O'Reilly Media.
3. Paul Zikopoulos et al. – Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw-Hill.

References:

1. Chuck Lam – Hadoop in Action, Manning Publications.
2. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman – Big Data for Dummies, Wiley.
3. Dean Wampler and Jason Rutherglen – Programming Hive, O'Reilly Media.

Online Resources:

Sr. No.	Website Name
1.	Apache Hadoop Official Documentation https://hadoop.apache.org/docs/
2.	MongoDB University (Free Courses) https://university.mongodb.com/
3.	Hive and Pig Tutorials by Tutorialspoint https://www.tutorialspoint.com/hive/ https://www.tutorialspoint.com/pig/
4.	MapReduce Tutorials by GeeksforGeeks https://www.geeksforgeeks.org/mapreduce-program-wordcount-example/
5.	Big Data Analytics Course by NPTEL https://nptel.ac.in/courses/106/104/106104189/
6.	edX – Big Data Analysis with Scala and Spark (University of California) https://www.edx.org/course/big-data-analysis-with-scala-and-spark

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
ECL784	Advanced DBMS Lab	-	2	-	-	1	-	1

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical / Oral	Total
		Internal assessment			End Sem. Exam			
		IAT1	IAT2	Total				
ECL784	Advanced Database Management Systems Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To implement advanced SQL queries including nested queries, views, triggers, and stored procedures for complex data operations.
2. To understand and apply query optimization techniques using cost-based and heuristic-based approaches.
3. To design and simulate indexing mechanisms like B-trees, hash indexing, and bitmap indexing for efficient data retrieval.
4. To implement concurrency control techniques such as locking protocols and timestamp ordering for transaction management.
5. To explore and simulate distributed and parallel database systems for managing data across multiple nodes.
6. To gain hands-on experience with NoSQL databases and big data tools to manage semi-structured and unstructured data efficiently.

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Lab Outcomes:

- 1) Build and manage indexes to improve database query performance.
- 2) Analyze time series data using appropriate open-source tools.
- 3) Perform data partitioning and understand its impact on query optimization.
- 4) Develop and execute programs using the MapReduce programming model.
- 5) Apply data preprocessing techniques for efficient large-scale data handling.
- 6) Design and implement data-intensive applications using big data technologies.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Create an index on the given tables, observe execution time of queries and record your observations.	2
02	Demonstrate use of grant and revoke access	2
03	Find the cost of queries using DBMS tools (Postgresql, MySQL, Oracle etc)	2
04	Data distribution and partitioning using Apache Ignite	2
05	Collocating computations with data using Apache Ignite	2
06	Time series data analysis using Temporal database like TimescaleDB	2
07	Count number of words in a large file using map reduce	2
08	Compare the cost required for query execution and obtain the optimized query	2
09	Develop a distributed database application. (FileServer Implementation using RMI)	2
10	Create a node and relationships using neo4j	2
11	Select and display data using neo4j	2
12	Create index and add constraints using neo4j	2

Text Books:



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1. Korth, Silberchatz, Sudarshan, : "Database System Concepts", 6th Edition, McGraw – Hill
2. Elmasri and Navathe, "Fundamentals of Database Systems", 6th Edition, PEARSON Education.
3. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems" 3rd Editi McGraw Hill

Reference Book:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online Resources:

Sr. No.	Website Name
1.	https://docs.timescale.com/timescaledb/latest/tutorials/nyc-taxi-cab/#introduction-to-iot-new-york-city-taxi-cabs
2.	https://neo4j.com/developer/get-started/
3	https://docs.timescale.com/install/latest/
4	https://hadoop.apache.org/

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)

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC709	Major Project-I	--	04	--	--	02	-	02

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT2	Total					
ECC709	Major Project-I	--	--	--	--	--	25	25	50

Rationale : The Major Project–I syllabus is designed to encourage students to apply theoretical knowledge and technical skills acquired during their course to solve real-world problems through practical implementation. It promotes innovation, teamwork, and project management skills by guiding students through the initial stages of research, design, and development under faculty supervision. This course lays the groundwork for Major Project and internship, fostering analytical thinking, creativity, and readiness for industry or higher research.

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Course Objectives:

1. To acquaint yourself with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint yourself with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Course Outcomes:

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as a member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Major Project:

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do surveys and identify needs, which shall be converted into problem statements for projects in consultation with faculty supervisor/head of department/internal committee of faculties.
- Students shall submit implementation plans in the form of Gantt/PERT/CPM charts, which will cover weekly activity of major project-I and major project-II.
- A log book to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.

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- Faculty supervisors may give inputs to students during major project -I & Internship activity; however, focus shall be on self-learning.
- Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor.
- Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of institute.
- With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Major Project, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Major Project-I in semester VII and continue in semester VIII.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Major Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to Scopus paper publications in Journal/Conference or Copyright or Patent as an extension of the Major Project-1 with suitable improvements/modifications after testing and analysis in even semester. This policy can be adopted on a case by case basis.

Guidelines for Assessment of Major Project:

Term Work:

- 1) The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major projects to be evaluated on a continuous basis, minimum two reviews in each semester VII and VIII.
- 2) In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- 3) Distribution of Term work marks for both semesters shall be as below;

a) Marks awarded by guide/supervisor based on log book:	10
b) Marks awarded by review committee	10
c) Quality of Project report	05

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Review/progress monitoring committee may consider following points for assessment based on either one year major project as mentioned in general guidelines.

One-year project:

- In semester VII entire theoretical solution shall be ready, including components/system selection and cost analysis, building of working prototype. Two reviews will be conducted based on the presentation given by the student group.
- First shall be for finalization of problem and proposed solution of the problem
- Second shall be on readiness of working and testing of prototype to be conducted.
- In semester VIII expected work shall be procurement of testing and validation of results based on work completed in an odd semester.
- First review is based on improvements in testing and validation results cum demonstration for publication to be conducted.
- Second review shall be based on paper presentation in conference/journal or motivation for copyright or Indian patent in the last month of the said semester.

Assessment criteria of Major Project.

Major Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
2. Clarity of Problem definition based on need.
3. Innovativeness in solutions
4. Feasibility of proposed problem solutions and selection of best solution
5. Cost effectiveness
6. Societal impact
7. Innovativeness
8. Cost effectiveness and Societal impact
9. Full functioning of working model as per stated requirements
10. Effective use of skill sets
11. Effective use of standard engineering norms
12. Contribution of an individual as member or leader
13. Clarity in written and oral communication

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- In **one year, project**, first semester evaluation may be based on the first six criteria and the remaining may be used for second semester evaluation of performance of students in the project.

Guidelines for Assessment of Major Project Practical/Oral Examination:

- The report should be prepared as per the guidelines issued by the University of Mumbai.
- Major Projects 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.
- Students shall be motivated to publish a paper based on the work in Scopus Conferences/Journals or copy right or Indian Patent.

Major Project

shall be assessed based on following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact

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Curriculum Structure – BE Semester-VII

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

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Course Code	Course Name	Credits
OEC7501	Product Life Cycle Management	03

Course Objectives: Students will try:

1. To familiarize the students with the need, benefits and components of PLM
2. To acquaint students with Product Data Management & PLM strategies
3. To give insights into new product development program and guidelines for designing and developing a product
4. To familiarize the students with Virtual Product Development

Course Outcomes: Students will be able to:

1. Gain knowledge about phases of PLM, PLM strategies and methodology for PLM feasibility study and PDM implementation.
2. Illustrate various approaches and techniques for designing and developing products.
3. Apply product engineering guidelines / thumb rules in designing products for moulding, machining, sheet metal working etc.
4. Acquire knowledge in applying virtual product development tools for components, machining and manufacturing plant

Module	Detailed Contents	Hrs
01	Introduction to Product Lifecycle Management (PLM):Product Lifecycle Management (PLM), Need for PLM, Product Lifecycle Phases, Opportunities of Globalization, Pre-PLM Environment, PLM Paradigm, Importance & Benefits of PLM, Widespread Impact of PLM, Focus and Application, A PLM Project, Starting the PLM Initiative, PLM Applications PLM Strategies:Industrial strategies, Strategy elements, its identification, selection and implementation, Developing PLM Vision and PLM Strategy , Change management for PLM	10



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02	ProductDesign: Product Design and Development Process, Engineering Design, Organization and Decomposition in Product Design, Typologies of Design Process Models, Reference Model, Product Design in the Context of the Product Development Process, Relation with the Development Process Planning Phase, Relation with the Post design Planning Phase, Methodological Evolution in Product Design, Concurrent Engineering, Characteristic Features of Concurrent Engineering, Concurrent Engineering and Life Cycle Approach, New Product Development (NPD) and Strategies, Product Configuration and Variant Management, The Design for X System, Objective Properties and Design for X Tools, Choice of Design for X Tools and Their Use in the Design Process	09
03	Product Data Management (PDM): Product and Product Data, PDM systems and importance, Components of PDM, Reason for implementing a PDM system, financial justification of PDM, barriers to PDM implementation	05
04	Virtual Product Development Tools: For components, machines, and manufacturing plants, 3D CAD systems and realistic rendering techniques, Digital mock-up, Model building, Model analysis, Modeling and simulations in Product Design, Examples/Case studies	05
05	Integration of Environmental Aspects in Product Design: Sustainable Development, Design for Environment, Need for Life Cycle Environmental Strategies, Useful Life Extension Strategies, End-of-Life Strategies, Introduction of Environmental Strategies into the Design Process, Life Cycle Environmental Strategies and Considerations for Product Design	05
06	Life Cycle Assessment and Life Cycle Cost Analysis: Properties, and Framework of Life Cycle Assessment, Phases of LCA in ISO Standards, Fields of Application and Limitations of Life Cycle Assessment, Cost Analysis and the Life Cycle Approach, General Framework for LCCA, Evolution of Models for Product Life Cycle Cost Analysis	05

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Course Code	Course Name	Credits
OEC7502	Reliability Engineering	03

Objectives:

1. To familiarize the students with various aspects of probability theory
2. To acquaint the students with reliability and its concepts
3. To introduce the students to methods of estimating the system reliability of simple and complex systems
4. To understand the various aspects of Maintainability, Availability and FMEA procedure

Outcomes: Learner will be able to...

1. Understand and apply the concept of Probability to engineering problems
2. Apply various reliability concepts to calculate different reliability parameters
3. Estimate the system reliability of simple and complex systems
4. Carry out a Failure Mode Effect and Criticality Analysis

Module	Detailed Contents	Hrs
01	Probability theory: Probability: Standard definitions and concepts; Conditional Probability, Baye's Theorem. Probability Distributions: Central tendency and Dispersion; Binomial, Normal, Poisson, Weibull, Exponential, relations between them and their significance. Measures of Dispersion: Mean, Median, Mode, Range, Mean Deviation, Standard Deviation, Variance, Skewness and Kurtosis.	08
02	Reliability Concepts: Reliability definitions, Importance of Reliability, Quality Assurance and Reliability, Bath Tub Curve. Failure Data Analysis: Hazard rate, failure density, Failure Rate, Mean Time To Failure (MTTF), MTBF, Reliability Functions. Reliability Hazard Models: Constant Failure Rate, Linearly increasing, Time Dependent Failure Rate, Weibull Model. Distribution functions and reliability analysis.	08



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03	System Reliability: System Configurations: Series, parallel, mixed configuration, k out of n structure, Complex systems.	05
04	Reliability Improvement: Redundancy Techniques: Element redundancy, Unit redundancy, Standby redundancies. Markov analysis. System Reliability Analysis – Enumeration method, Cut-set method, Success Path method, Decomposition method.	08
05	Maintainability and Availability: System downtime, Design for Maintainability: Maintenance requirements, Design methods: Fault Isolation and self-diagnostics, Parts standardization and Interchangeability, Modularization and Accessibility, Repair Vs Replacement. Availability – qualitative aspects.	05
06	Failure Mode, Effects and Criticality Analysis: Failure mode effects analysis, severity/criticality analysis, FMECA examples. Fault tree construction, basic symbols, development of functional reliability block diagram, Fault tree analysis and Event tree Analysis	05

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Course Code	Course Name	Credits
OECE7503	Management Information System	03

Objectives:

1. The course is a blend of Management and Technical field.
2. Discuss the roles played by information technology in today's business and define various technology architectures on which information systems are built
3. Define and analyze typical functional information systems and identify how they meet the needs of the firm to deliver efficiency and competitive advantage
4. Identify the basic steps in systems development

Outcomes: Learner will be able to...

1. Explain how information systems Transform Business
2. Identify the impact information systems have on an organization
3. Describe IT infrastructure and its components and its current trends
4. Understand the principal tools and technologies for accessing information from databases to improve business performance and decision making
5. Identify the types of systems used for enterprise-wide knowledge management and how they provide value for businesses

Module	Detailed Contents	Hrs
01	Introduction To Information Systems (IS): Computer Based Information Systems, Impact of IT on organizations, Importance of IS to Society. Organizational Strategy, Competitive Advantages and IS.	4
02	Data and Knowledge Management: Database Approach, Big Data, Data warehouse and Data Marts, Knowledge Management. Business intelligence (BI): Managers and Decision Making, BI for Data analysis and Presenting Results	7
03	Ethical issues and Privacy: Information Security. Threat to IS, and Security Controls	7



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04	Social Computing (SC): Web 2.0 and 3.0, SC in business-shopping, Marketing, Operational and Analytic CRM, E-business and E-commerce – B2B B2C. Mobile commerce.	7
05	Computer Networks Wired and Wireless technology, Pervasive computing, Cloud computing model.	6
06	Information System within Organization: Transaction Processing Systems, Functional Area Information System, ERP and ERP support of Business Process. Acquiring Information Systems and Applications: Various System development life cycle models.	8

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Course Code	Course Name	Credits
OEC7504	Design of Experiments	03

Objectives:

1. To understand the issues and principles of Design of Experiments (DOE)
2. To list the guidelines for designing experiments
3. To become familiar with methodologies that can be used in conjunction with experimental designs for robustness and optimization

Outcomes: Learner will be able to...

1. Plan data collection, to turn data into information and to make decisions that lead to appropriate action
2. Apply the methods taught to real life situations
3. Plan, analyze, and interpret the results of experiments

2.

Module	Detailed Contents	Hrs
01	Introduction Strategy of Experimentation Typical Applications of Experimental Design Guidelines for Designing Experiments Response Surface Methodology	06
02	Fitting Regression Models Linear Regression Models Estimation of the Parameters in Linear Regression Models Hypothesis Testing in Multiple Regression Confidence Intervals in Multiple Regression Prediction of new response observation Regression model diagnostics Testing for lack of fit	08



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03	Two-Level Factorial Designs The 2^2 Design The 2^3 Design The General 2^k Design A Single Replicate of the 2^k Design The Addition of Center Points to the 2^k Design, Blocking in the 2^k Factorial Design Split-Plot Designs	07
04	Two-Level Fractional Factorial Designs The One-Half Fraction of the 2^k Design The One-Quarter Fraction of the 2^k Design The General 2^{k-p} Fractional Factorial Design Resolution III Designs Resolution IV and V Designs Fractional Factorial Split-Plot Designs	07
05	Response Surface Methods and Designs Introduction to Response Surface Methodology The Method of Steepest Ascent Analysis of a Second-Order Response Surface Experimental Designs for Fitting Response Surfaces	07



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06	Taguchi Approach Crossed Array Designs and Signal-to-Noise Ratios Analysis Methods Robust design examples	04

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Course Code	Course Name	Credits
OEC7505	Operations Research	03

Objectives:

1. Formulate a real-world problem as a mathematical programming model.
2. Understand the mathematical tools that are needed to solve optimization problems.
3. Use mathematical software to solve the proposed models.

Outcomes: Learner will be able to...

1. Understand the theoretical workings of the simplex method, the relationship between a linear program and its dual, including strong duality and complementary slackness.
2. Perform sensitivity analysis to determine the direction and magnitude of change of a model's optimal solution as the data change.
3. Solve specialized linear programming problems like the transportation and assignment problems, solve network models like the shortest path, minimum spanning tree, and maximum flow problems.
4. Understand the applications of integer programming and a queuing model and compute important performance measures

Module	Detailed Contents	Hrs
01	Introduction to Operations Research: Introduction, , Structure of the Mathematical Model, Limitations of Operations Research Linear Programming: Introduction, Linear Programming Problem, Requirements of LPP, Mathematical Formulation of LPP, Graphical method, Simplex Method Penalty Cost Method or Big M-method, Two Phase Method, Revised simplex method, Duality , Primal – Dual construction, Symmetric and Asymmetric Dual, Weak Duality Theorem, Complimentary Slackness Theorem, Main Duality Theorem, Dual Simplex Method, Sensitivity Analysis Transportation Problem: Formulation, solution, unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test: the stepping stone method and MODI method.	14



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	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.	
02	Queuing models: queuing systems and structures, single server and multi-server models, Poisson input, exponential service, constant rate service, finite and infinite population	05
03	Simulation: Introduction, Methodology of Simulation, Basic Concepts, Simulation Procedure, Application of Simulation Monte-Carlo Method: Introduction, Monte-Carlo Simulation, Applications of Simulation, Advantages of Simulation, Limitations of Simulation	05
04	Dynamic programming. Characteristics of dynamic programming. Dynamic programming approach for Priority Management employment smoothening, capital budgeting, Stage Coach/Shortest Path, cargo loading and Reliability problems.	05
05	Game Theory. Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 X 2 games.	05
06	Inventory Models: Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model,	05

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Course Code	Course Name	Credits
OEC7506	Cyber Security and Laws	03

Objectives:

1. To understand and identify different types cybercrime and cyber law
2. To recognized Indian IT Act 2008 and its latest amendments
3. To learn various types of security standards compliances

Outcomes: Learner will be able to...

1. Understand the concept of cybercrime and its effect on outside world
2. Interpret and apply IT law in various legal issues
3. Distinguish different aspects of cyber law
4. Apply Information Security Standards compliance during software design and development

Module	Detailed Contents	Hrs
01	Introduction to Cybercrime: Cybercrime definition and origins of the world, Cybercrime and information security, Classifications of cybercrime, Cybercrime and the Indian ITA 2000, A global Perspective on cybercrimes.	4
02	Cyber offenses & Cybercrime: How criminal plan the attacks, Social Engg, Cyber stalking, Cyber café and Cybercrimes, Bot nets, Attack vector, Cloud computing, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Devices-Related Security Issues, Organizational Security Policies and Measures in Mobile Computing Era, Laptops	9
03	Tools and Methods Used in Cyber line Phishing, Password Cracking, Key loggers and Spywares, Virus and Worms,	6

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	Steganography, DoS and DDoS Attacks, SQL Injection, Buffer Over Flow, Attacks on Wireless Networks, Phishing, Identity Theft (ID Theft)	
04	The Concept of Cyberspace E-Commerce , The Contract Aspects in Cyber Law ,The Security Aspect of Cyber Law ,The Intellectual Property Aspect in Cyber Law, The Evidence Aspect in Cyber Law , The Criminal Aspect in Cyber Law, Global Trends in Cyber Law , Legal Framework for Electronic Data Interchange Law Relating to Electronic Banking , The Need for an Indian Cyber Law	8
05	Indian IT Act. Cyber Crime and Criminal Justice : Penalties, Adjudication and Appeals Under the IT Act, 2000, IT Act. 2008 and its Amendments	6
06	Information Security Standard compliances SOX, GLBA, HIPAA, ISO, FISMA, NERC, PCI.	6



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R-2025- B.E.(SemVII) Electronics and Computer Science

Course Code	Course Name	Credits
OEC7507	Disaster Management and Mitigation Measures	03

Objectives:

1. To understand physics and various types of disaster occurring around the world
2. To identify extent and damaging capacity of a disaster
3. To study and understand the means of losses and methods to overcome /minimize it.
4. To understand role of individual and various organization during and after disaster
5. To understand application of GIS in the field of disaster management
6. To understand the emergency government response structures before, during and after disaster

Outcomes: Learner will be able to...

1. Get to know natural as well as manmade disaster and their extent and possible effects on the economy.
2. Plan of national importance structures based upon the previous history.
3. Get acquainted with government policies, acts and various organizational structure associated with an emergency.
4. Get to know the simple do's and don'ts in such extreme events and act accordingly.

Module	Detailed Contents	Hrs
01	Introduction Definition of Disaster, hazard, global and Indian scenario, general perspective, importance of study in human life, Direct and indirect effects of disasters, long term effects of disasters. Introduction to global warming and climate change.	03
02	Natural Disaster and Manmade disasters: Natural Disaster: Meaning and nature of natural disaster, Flood, Flash flood, drought, cloud burst, Earthquake, Landslides, Avalanches, Volcanic eruptions, Mudflow, Cyclone, Storm, Storm Surge, climate change, global warming, sea level rise, ozone depletion. Manmade Disasters: Chemical, Industrial, Nuclear and Fire Hazards. Role of growing population and subsequent industrialization, urbanization and changing lifestyle of human beings in frequent occurrences of manmade disasters.	09

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03	Disaster Management, Policy and Administration Disaster management: meaning, concept, importance, objective of disaster management policy, disaster risks in India, Paradigm shift in disaster management. Policy and administration: Importance and principles of disaster management policies, command and co-ordination of in disaster management, rescue operations-how to start with and how to proceed in due course of time, study of flowchart showing the entire process.	06
04	Institutional Framework for Disaster Management in India: importance of public awareness, Preparation and execution of emergency management programme. Scope and responsibilities of National Institute of Disaster Management (NIDM) and National disaster management authority DMA) 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
05	Financing Relief Measures: Ways to raise finance for relief expenditure, role of government agencies and NGO's in this process, Legal aspects related to finance raising as well as overall management of disasters. Various NGO's and the works they have carried out in the past on the occurrence of various disasters, Ways to approach these teams. International relief aid agencies and their role in extreme events.	09
06	Preventive and Mitigation Measures: Pre-disaster, during disaster and post-disaster measures in some events in general Structural mapping: Risk mapping, assessment and analysis, sea walls and embankments, Bio shield, shelters, early warning and communication Non Structural Mitigation: Community based disaster preparedness, risk transfer and risk financing, capacity development and training, awareness and education, contingency plans. Do's and don'ts in case of disasters and effective implementation of relief aids.	06



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Course Code	Course Name	Credits
OEC7508	Energy Audit and Management	03

Objectives:

1. To understand the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities.

Outcomes: Learner will be able to...

1. To identify and describe the present state of energy security and its importance.
2. To identify and describe the basic principles and methodologies adopted in energy audit of an utility.
3. To describe the energy performance evaluation of some common electrical installations and identify the energy saving opportunities.
4. To describe the energy performance evaluation of some common thermal installations and identify the energy saving opportunities
5. To analyze the data collected during performance evaluation and recommend energy saving measures

Module	Detailed Contents	Hrs
01	Energy Scenario: Present Energy Scenario, Energy Pricing, Energy Sector Reforms, Energy Security, Energy Conservation and its Importance, Energy Conservation Act- 2001 and its Features. Basics of Energy and its various forms, Material and Energy balance	04

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02	Energy Audit Principles: Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Benchmarking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution. Elements of monitoring & targeting; Energy audit Instruments; Data and information-analysis. Financial analysis techniques: Simple payback period, NPV, Return on investment (ROI), Internal rate of return (IRR)	08
03	Energy Management and Energy Conservation in Electrical System: Electricity billing, Electrical load management and maximum demand Control; Power factor improvement, Energy efficient equipment and appliances, star ratings. Energy efficiency measures in lighting systems, Lighting control: Occupancy sensors, daylight integration, and use of intelligent controllers. Energy conservation opportunities in: water pumps, industrial drives, induction motors, motor retrofitting, soft starters, variable speed drives.	10
04	Energy Management and Energy Conservation in Thermal Systems: Review of different thermal loads; Energy conservation opportunities in: Steam distribution system, Assessment of steam distribution losses, Steam leakages, Steam trapping, Condensate and flash steam recovery system. General fuel economy measures in Boilers and furnaces, Waste heat recovery, use of insulation- types and application. HVAC system: Coefficient of performance, Capacity, factors affecting Refrigeration and Air Conditioning system performance and savings opportunities.	10
05	Energy Performance Assessment: On site Performance evaluation techniques, Case studies based on: Motors and variable speed drive, pumps, HVAC system calculations; Lighting System: Installed Load Efficacy Ratio (ILER) method, Financial Analysis.	04
06	Energy conservation in Buildings: Energy Conservation Building Codes (ECBC): Green Building, LEED rating, Application of Non-Conventional and Renewable Energy Sources	03



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R-2025- B.E.(SemVII) Electronics and Computer Science

Course Code	Course Name	Credits
OEC7509	Development Engineering	03

Objectives:

1. To familiarise the characteristics of rural Society and the Scope, Nature and Constraints of rural Development
2. To provide an exposure to implications of 73rdCAA on Planning, Development and Governance of Rural Areas
3. An exploration of human values, which go into making a 'good' human being, a 'good' professional, a 'good' society and a 'good life' in the context of work life and the personal life of modern Indian professionals
4. To familiarise the Nature and Type of Human Values relevant to Planning Institutions

Outcomes: Learner will be able to...

1. Demonstrate understanding of knowledge for Rural Development.
2. Prepare solutions for Management Issues.
3. Take up Initiatives and design Strategies to complete the task
4. Develop acumen for higher education and research.
5. Demonstrate the art of working in group of different nature
6. Develop confidence to take up rural project activities independently

Module	Contents	Hrs
1	Introduction to Rural Development Meaning, nature and scope of development; Nature of rural society in India; Hierarchy of settlements; Social, economic and ecological constraints for rural development. Roots of Rural Development in India Rural reconstruction and Sarvodaya programme before independence; Impact of voluntary effort and Sarvodaya Movement on rural development; Constitutional direction, directive principles; Panchayati Raj - beginning of planning and community development; National extension services.	08
2	Post-Independence rural Development Balwant Rai Mehta Committee - three tier system of rural local Government; Need and scope for people's participation and Panchayati Raj; Ashok Mehta Committee - linkage between Panchayati Raj, participation and rural development.	06
3	Rural Development Initiatives in Five Year Plans Five Year Plans	07

	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 component plan and sub-plan for the weaker section; Micro-eco zones; Data base for local planning; Need for decentralized planning; Sustainable rural development	
4	Post 73rd Amendment Scenario 73rd Constitution Amendment Act, including - XI schedule, devolution of powers, functions and finance; Panchayati Raj institutions organizational linkages; Recent changes in rural local planning; Gram Sabha - revitalized Panchayati Raj; Institutionalization; resource mapping, resource mobilization including social mobilization; Information Technology and rural planning; Need for further amendments.	04
5	Values and Science and Technology Material development and its values; the challenge of science and technology; Values in planning profession, research and education Types of Values Psychological values — integrated personality; mental health; Societal values — the modern search for a good society; justice, democracy, rule of law, values in the Indian constitution; Aesthetic values — perception and enjoyment of beauty; Moral and ethical values; nature of moral judgment; Spiritual values; different concepts; secular spirituality; Relative and absolute values; Human values— humanism and human values; human rights; human values as freedom, creativity, love and wisdom	10
6	Ethics Canons of ethics; ethics of virtue; ethics of duty; ethics of responsibility; Work ethics; Professional ethics; Ethics in planning profession, research and education	04

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SEM VIII



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC801	Robotics	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC801	Robotics	20	20	40	60	2.5	--	--	100

Rationale:

The purpose of robotics is to design, build, and use robots to perform tasks that are difficult, dangerous, or repetitive for humans, ultimately aiming to improve efficiency, safety, and quality of life.

Course Objectives:

To introduce robot types, components, joints, coordinates, and specifications.

1. To explain mathematical models and transformations for robot positioning.
2. To study inverse kinematics and analyze robot workspaces.
3. To understand motion trajectories in joint and Cartesian space.
4. To explore robotic task planning and motion under uncertainty.
5. To study vision techniques and robot programming languages.



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Course Outcomes:

After successful completion of the course students will be able to:

1. *Identify* various types, components, and coordinate systems of robots.
2. *Apply* dot and cross products and *compute* arm equations using transformation matrices.
3. *Solve* inverse kinematics problems and *analyze* workspace limitations of robotic manipulators.
4. *Design* and *evaluate* joint-space and Cartesian-space trajectories for robotic motions.
5. *Simulate* path planning and *compare* different planning algorithms under uncertainty.
6. *Implement* basic vision techniques and *differentiate* among robot programming languages and control software.

Prerequisite: Applied Mathematics III, Applied Mathematics IV, Controls and Instrumentation

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	2D/3D coordinate transformations, Vectors and matrices, Open-loop and closed-loop control, Basic image processing	02	
I	Fundamentals of Robotics	Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Specification Notations, Applications.	04	CO1
II	Direct Kinematics	Dot and Cross Products, Co-ordinate frames, Rotations, Homogeneous Co-	07	CO2



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		ordinates, Link Co-ordinates, Arm Equation (3 axis and 4 axis Robots)		
III	Inverse Kinematics and Work Space Analysis	General properties of solutions, Tool Configuration, Inverse kinematics of 3 axis, 4 axis and 5 axis Robots, Work Space Analysis of 3 axis and 4 axis Robots, Work Envelope.	07	CO3
IV	Trajectory planning	Basics of Trajectory planning , Joint-space trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion	04	CO4
V	Task Planning	Task level programming, Uncertainty, Configuration Space, Gross motion Planning; Grasp planning, Fine-motion Planning, Simulation of Planer motion, Source and goal scenes, BUG 1, BUG 2 and Tangent Bug Algorithms	07	CO5
VI	Robot Vision and Robot Languages	Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform. Robot language, Classification of Robot languages, Computer control and Robot software, Variable Assembly Language system and language	08	CO6



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Text Books:

1. Robert Shilling, “Fundamentals of Robotics - Analysis and control, Prentice Hall of India, 2009
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

References:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006
3. Mikell P. Groover et.al, ”Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008
5. S. R. Deb and Sankha Deb, “Robotics Technology and Flexible Automation” , Second Edition. TMH



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC821	MEMS Technology	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pr act / Or al	Total
		Internal Assessment			End Sem Exam	Exam Durati on (in Hrs)			
		IAT 1	IAT 2	Total					
ECC821	MEMS Technology	20	20	40	60	2.5	--	--	100

Course Objectives:

- 1 To provide knowledge of MEMS fabrication steps.
2. To provide knowledge of MEMS Materials with respect to applications.
3. To demonstrate the use of semiconductor-based fabrication processes for sensors and actuators
4. To provide an understanding of basic design and operation of MEMS sensors, actuators and passive structures.

Course Outcomes:



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After successful completion of the course students will be able to:

1. Understand the different MEMS devices, working principles.
2. Understand MEMS materials and their properties.
3. Develop different concepts of MEMS sensors and actuators for real-world applications
4. Understand the rudiments of Micro-fabrication techniques
5. Understand Construction, working applications and fabrications steps of MEMS devices.
6. To understand reliability of MEMS devices after fabrication process.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to MEMS	1.1 Introduction to MEMS and Micro Electronics Technologies.	04	CO1
		1.2 MEMS in Real world applications such as Air-Bag, DMD, Pressure Sensors, MEMS Challenges, MEMS Sensors in Internet of Things (IoT), Bio-medical applications		
II	MEMS Materials and Their Properties	2.1 Use of Si, SiO ₂ , SiN, SiC, Cr, Au, Al, Ti, SU8, PMMA, Pt in building MEMS applications.	07	CO2
		2.2 Material properties such as Young modulus, Poisson's ratio, density, piezo resistive coefficients, TCR, Thermal Conductivity, Thermoelectricity.		
III	MEMS Sensors and Actuators	3.1 Types MEMS Sensing (Capacitive, Piezo electric Piezo resistive)	08	CO3
		3.2 Micro Actuation Techniques (Thermal, Piezo electric, Electro static), Shape Memory Alloys, Micro Grippers, Micro Gears, Micro Motors, Micro Valves, Micro Pumps.		
IV		4.1 MEMS Processes & Process parameters: Bulk & Surface Micromachining, High Aspect	08	CO4



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	MEMS Fabrication Processes	Ratio MEMS (LIGA) .		
		4.2 X-Ray Lithography, Photolithography, PVD, Wet etching, Dry etching, Plasma etching, DRIE, Etch Stop Techniques, Die, Wire & Wafer Bonding, Dicing, Packaging.		
V	MEMS Devices	5.1 Construction and working and applications of basic Cantilever structure, Micro heaters, Accelerometers, Pressure Sensor , Micromirrors in DMD, Inkjet printer ,Steps involved in fabrication of above devices.	09	CO5
VI	MEMS Reliability	6.1 Reliability and various failure mechanisms for MEMS. 6.2 Reliability curve.	03	CO6
	MEMS Reliability	6.1 Reliability and various failure mechanisms for MEMS. 6.2 Reliability curve.		
Total			39	

Text Books:

1. An Introduction to Micro-Electromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc.
2. Micro-system Design - by S. Senturia; Publisher: Springer.
3. Introduction to Electromechanical system design –by James J Allen. Taylor & Francis Group, LLC publication

Reference Books:

1. Fundamentals of Micro-fabrication - by M. Madou; Publisher: CRC Press; 2nd edition.
2. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill4.

Online References:



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Sr. No.	Website Name
1.	https://nptel.ac.in/courses/117105082
2.	https://archive.nptel.ac.in/courses/108/108/108108113/

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC822	Natural Language Processing	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC822	Natural Language Processing	20	20	40	60	2.5	--	--	100

Rationale:

Natural Language Processing (NLP) is a vital area of artificial intelligence that enables computers to understand and interact with human language. This subject equips students with the skills to develop applications like chatbots, translators, and sentiment analyzers, combining knowledge from linguistics, computer science, and machine learning. As NLP is widely used in industries such as tech, healthcare, and finance, learning it boosts employability and prepares students for advanced AI work. The course also promotes innovation and helps address real-world challenges in communication and information processing.



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Course Objectives:

1. To understand natural language processing and to learn how to apply basic algorithms in this field.
2. To get acquainted with the basic concepts and algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics.
3. To design and implement applications based on natural language processing

Course Outcomes:

1. Have a broad understanding of the field of natural language processing.
2. Understand the mathematical and linguistic preliminaries necessary for various processes in NLP
3. Be able to Design, implement and test algorithms for NLP problems
4. Perform Word-Level, Syntax-Level and Semantic-Level Analysis
5. Develop basic understanding of Pragmatics in NLP
6. Be able to apply NLP techniques to design real world NLP applications

Prerequisite:

Python, mathematics (calculus, linear algebra, probability, and statistics), and machine learning

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Python, mathematics (calculus, linear algebra, probability, and statistics), and machine learning		
I	Introduction to Natural Language Processing	The need of NLP. Generic NLP system, Levels of NLP 02 Stages in building a Natural Language Processing System. Challenges and ambiguities in NLP Design	6	CO1



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II	Mathematical and Linguistic Preliminaries	Probability Theory, Conditional Probability and Independence, Bayes Rule, Random Variables, Probability Distributions, Statistics, Counting, Frequency, Mean and Variance 04 English Grammar, Parts of Speech, Phrase Structures	6	CO2
III	Word Level Analysis	Tokenization, Segmentation, Lemmatization, Edit Distance, Collocations, Porter Stemmer, N-gram Language Model 04 Morphological Analysis, Derivational and Reflectional Morphology	6	CO3
IV	Syntax-Analysis	Tag set for English, Penn Tree bank, Introduction to Parts of Speech Tagging (POST) 02 Markov Processes, Hidden Markov Models (HMM) 02 Parts of Speech Tagging using Hidden Markov Models, Viterbi Algorithm	8	CO4
V	Semantic Analysis	Lexical Semantics, ambiguous words, word senses, Relations between senses: synonym, antonym, reversives, hyponym, hypernym, meronym, structured polysemy, metonymy, zeugma Introduction to WordNet, gloss, synset, sense relations in WordNet. Cosine distance between documents. Word sense disambiguation.	8	CO5
VI	Pragmatics and applications of NLP	Reference resolution: Discourse model, Reference Phenomenon, Syntactic and Semantic Constraints on co reference	5	CO6



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		Applications of NLP: Categorization, Summarization, Sentiment Analysis, Named Entity Recognition, Machine Translation, Information Retrieval, Question Answer System		

Text Books:

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

References:

1. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
2. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor), The Handbook of Computational

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2.	https://www.coursera.org/specializations/natural-language-processing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC823	3-D Printing and Design	3	2	-	3	1	-	4

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC823	3-D Printing and Design	20	20	40	60	2.5	--	--	100

Rationale:

With the rising influence of digital manufacturing, **3D Printing and Design** serves as a bridge between creativity and engineering. It enables rapid prototyping, sustainable manufacturing, and innovation across industries—from healthcare and aerospace to art and education.

Course Objectives:

1. Understand the fundamentals and evolution of 3D printing technology.
2. Develop 3D models using appropriate design software.
3. Evaluate different 3D printing processes and materials.
4. Analyze the application of 3D printing in industrial and social contexts.
5. Apply principles of sustainable design using additive manufacturing.
6. Promote entrepreneurial thinking through product design challenges.



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Course Outcomes:

On successful completion of the course learner will be able to:

- 1) Explain the evolution of additive manufacturing and differentiate between subtractive and additive processes, highlighting their relevance to global industry trends.
- 2) Compare various 3D printing technologies (FDM, SLA, SLS, MJF, etc.) based on resolution, materials, and cost, and evaluate their suitability for real-world applications.
- 3) Use CAD tools to create printable 3D models by applying design guidelines and troubleshooting techniques for successful print preparation.
- 4) Identify and select appropriate materials based on application requirements, environmental impact, and sustainability considerations.
- 5) Analyze the impact of 3D printing across sectors like healthcare, aerospace, and construction, including ethical and social implications through real-world case studies.
- 6) Apply design thinking to 3D printing-based product development and explore entrepreneurial opportunities within the scope of Atmanirbhar Bharat and digital manufacturing.

Prerequisite: Engineering Drawing, Basic Computer Literacy and CAD tools, Basics of Materials Science

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to 3D Printing	Definition and Evolution of Additive Manufacturing Subtractive vs Additive Manufacturing Overview of 3D Printing Technologies Global trends and relevance to Industry	8	CO1
II	Types of 3D Printing Technologies	FDM (Fused Deposition Modeling) SLA (Stereolithography) SLS (Selective Laser Sintering) Inkjet, Binder Jetting, Multi Jet Fusion (MJF)	6	CO2



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		Comparison of processes based on resolution, cost, and materials		
III	CAD Modeling and Design for 3D Printing	Introduction to 3D modeling tools (TinkerCAD, Fusion 360, SolidWorks) Design guidelines for 3D printing STL generation, slicing and print preparation Troubleshooting design issues	6	CO3
IV	Materials and Sustainability in 3D Printing	Thermoplastics (PLA, ABS), Resins, Composites, Metals Sustainable material choices (bioplastics, recycled filaments) Material selection based on application and environmental impact Lifecycle and waste management	7	CO4
V	Applications and Real-World Case Studies	Biomedical devices (prosthetics, dental models) Aerospace, automotive, construction, education	5	CO5
VI	Innovation, Entrepreneurship and Industry Use-Cases	Prototyping to production Design Thinking in 3D product innovation Entrepreneurship opportunities in 3D printing startups Policies and future of digital manufacturing in India (Atmanirbhar Bharat)	7	CO6

Text Books:

1. Chua Chee Kai, Kah Fai Leong, Chu Sing Lim – "Rapid Prototyping: Principles and Applications", World Scientific Publishing, 5th Edition.
2. Andreas Gebhardt, Jan-Steffen Hötter – "Additive Manufacturing: 3D Printing for Prototyping and Manufacturing", Hanser Publications.
3. Joan Horvath, Rich Cameron – "3D Printing with Autodesk 123D, Tinkercad, and MakerBot", Apress.
4. Ian Gibson, David Rosen, Brent Stucker – "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Springer.



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References:

- 1) Ben Redwood, Filemon Schöffner, Brian Garret – *"The 3D Printing Handbook: Technologies, Design and Applications"*, 3D Hubs.
- 2) Andreas Bastian – *"Design for Additive Manufacturing: Concepts and Applications"*, MIT Additive Manufacturing Center (Online Resource).
- 3) Lior Shamir (Ed.) – *"Biomedical Applications of 3D Printing"*, MDPI – Open Access Scientific Journal (Selected Articles).
- 4) Savio Chauhan, Manish Kumar – *"3D Printing and Additive Manufacturing Technologies"*, Springer India.

Online References:

Sr. No.	Website Name
1.	MDPI.com – Open-access scientific books and journals on additive manufacturing
2.	<u>mitpress.mit.edu</u> – MIT Press open-source books (e.g., <i>Open-Source Lab</i>)
3.	<u>worldscientific.com</u> – Publisher of foundational textbooks in 3D printing
4.	<u>alison.com</u> – Free certification courses on 3D printing



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC824	Advanced Algorithms	03	02	-	03	01	-	04

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC824	Advanced Algorithms	20	20	40	60	2.5	--	--	100

Rationale:

The study of advanced algorithms equips students with the tools to design efficient, scalable solutions for complex computational problems beyond the scope of basic techniques.

Course Objectives:

1. To provide mathematical approaches for Analysis of Algorithms
2. To understand and solve problems using various algorithmic approaches
3. To analyse algorithms using various methods



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Course Outcomes:

At the end of the course learner will be able to

1. Analyze the running time and space complexity of algorithms.
2. Describe, apply and analyze the complexity of divide and conquer, greedy and dynamic programming strategy.
3. Identify appropriate data structures and design techniques for different problems
4. Differentiate polynomial and non-deterministic polynomial algorithms.
5. Analyze various algorithms.

Prerequisite: Data structure concepts, Discrete structure

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Introduction to analysis of algorithm	Mathematical background for algorithm analysis, Growth of function – Big –Oh, Omega, Theta notation, Complexity derivations, Solving recurrences using Substitution Method, Recursion tree method and Master method Complexity Classes: P, NP, NP Hard, NP Complete .Amortised Analysis -Aggregate Method, Accounting Method, Potential Method	07	CO1
II	Divide and Conquer approach	General method, Binary Search, Merge Sort, Quick Sort, Randomized quicksort, and Min-max algorithm	06	CO2



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III	Greedy Algorithms	General Method, Knapsack Problem, Huffman's Codes , Minimum Spanning Tree, Kruskal's Algorithm , Prim's Algorithm , Dijkstra's Algorithm	06	CO3
IV	Dynamic Programming Approach	General Method, Making coin change, Principle of optimality, Knapsack Problem, Matrix Chain Multiplication, Activity Selection Problem, Longest common subsequence, All pair shortest path algorithm	08	CO4
V	Maximum Flow	Flow networks, Ford Fulkerson method, Max bipartite matching , Push relabel algorithm , The relabel to front algorithm	06	CO5
VI	Classical Problems in Algorithms	Travelling Salesman problem, Subset Sum Problem, Matrix Multiplication, 15 puzzle , N-queens problem	06	CO5
Total			39	

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
3. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009
4. R.K. Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and



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Applications”, PrenticeHall Englewood Cliffs, NJ 1993.

References:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online References:

Sr. No.	Website Name
1.	NPTEL course: https://nptel.ac.in/courses/106105164
2.	Coursera link: https://www.coursera.org/specializations/algorithms



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC831	Advanced Networking Technologies	03	--	-	03	--	-	03

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC831	Advanced Networking Technologies	20	20	40	60	2.5	—	—	100

Rationale:

Advanced networking technologies are crucial for modern digital infrastructure, enabling efficient communication, enhanced security, and innovative applications across various industries. They drive digital transformation by facilitating data-driven technologies like IoT, AI, and cloud computing, supporting reliable, high-performance communication.

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These technologies are not just about connectivity; they are about enabling new business models, improving user experiences, and ensuring robust security.

Course Objectives:

1. Understand the characteristic features of Various Wireless networks.
2. Understand the characteristic features of ATM networks.
3. Introduce the need for network security and safeguards.

Course Outcomes:

After successful completion of the course students will be able to:

1. Appreciate the need for Wireless networks and study the IEEE 802.11 Standards
2. Comprehend the significance of Asynchronous Transfer Mode(ATM).
3. Analyze the importance of Optical networking.
4. Demonstrate knowledge of network design and security and management.
5. Understand the concept of multimedia networks.
6. Comprehend the significance of Network Design.

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
I	Wireless LAN and WAN Technologies	Introduction to Wireless networks : Infrastructure networks, Ad-hoc networks, IEEE 802.11 architecture and services ,Medium Access Control sub-layers,CSMA/CA, Physical Layer, 802.11,Security considerations Asynchronous Transfer Mode (ATM): Architecture, ATM logical connections, ATM	08	CO1



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		cells , ATM Functional Layers, Congestion control and Quality of service		
II	Optical Networking	SONET : SONET/SDH, Architecture, Signal, SONET devices, connections, SONET layers, SONET frames, STS Multiplexing, SONET Networks WDM, DWDM: Frame format, DWDM architecture ,Optical Amplifier , Optical cross connect Performance and design considerations.	06	CO2
III	Routing in the Internet	Intra and inter domain Routing, Unicast Routing Protocols: RIP, OSPF, BGP Multicast Routing Protocols ,Drawbacks of traditional Routing methods	08	CO3
IV	Network Security	Security goal, Security threats, security safeguards, firewall types and design, IP TABLES Internet Security: Network Layer Security, Transport Layer Security, Application Layer Security	08	CO4
V	Multimedia Information and Networking	Compression Fundamentals, Digital Representation, Compression techniques, Multimedia Communication across networks, RTP, RTSP, SIP,H..323	06	CO5
VI	Network Design	3 tier Network design layers: Application layer, Access layer. Backbone layers, Ubiquitous computing and Hierarchical computing	03	CO6
Total			39	



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Text Books:

1. Behrouz A. Forouzan, "Data communication and networking ", McGraw Hill Education, Fourth Edition.
2. J F. Kurose & KW. Ross: Computer Networking- A Top-down Approach featuring the Internet, 3rd edition,
3. Darren L. Spohn , "Data Network Design" , McGraw Hill Education ,Third edition
4. William Stallings, "Data and Computer communications", Pearson Education, 10th Edition

Reference Books:

1. K. R. Rao et al: Multimedia Communication Systems, Prentice-Hall of India,.
2. Deven Shah , Ambavade, "Advanced Communication Networking"
3. Behrouz A Forouzan , "TCP /IP Protocol Suite" , Tata McGraw Hill Education ,4th edition

Online References:

Sr. No.	Website Name
1.	https://nptel.ac.in/courses/106106243
2.	https://onlinecourses.nptel.ac.in/noc23_cs35/preview

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC832	Multimedia System and Virtual reality	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Prac t / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC832	Multimedia System and Virtual reality	20	20	40	60	2.5	--	--	100

Rationale

The Multimedia Systems and Virtual Reality subject is relevant because it equips students with the skills to design and develop interactive, immersive experiences using multimedia technologies. This field is rapidly growing, finding applications in diverse areas like education, entertainment, and training. Virtual reality, in particular, offers unique learning opportunities through simulation and immersive engagement, enhancing knowledge retention and engagement.

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Course Objectives:

1. To introduce students about basic fundamentals and key aspects of the multimedia system.
2. To provide knowledge of compression techniques of different multimedia components.
3. To discuss the multimedia authoring tools and security in multimedia systems.
4. To comprehend and analyse the fundamentals of virtual reality systems.
5. To learn different pipeline and modelling techniques in virtual reality.
6. To understand various programming languages in virtual reality.

Course Outcomes:

1. Understand the basics of multimedia and multimedia system architecture.
2. Analyze file formats and compression algorithms for different multimedia components.
3. Understand multimedia authoring systems and apply security techniques in multimedia environments.
4. Define the fundamentals of virtual reality and its related technologies.
5. Understand typical rendering pipeline and modelling techniques.
6. Design an application with the principles of virtual reality.

Prerequisite: Computer Fundamentals, Graphics, Communication Theory, ISO-OSI Model, Java Classes

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
		Definition of Multimedia, Characteristics of Multimedia System, History of Multimedia System, Difference between Multimedia and Hypermedia, Objects and Elements of Multimedia, Applications of Multimedia. Multimedia System Architecture: Workstation Architecture, IMA Architectural Framework, Network	05	CO1

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		Architecture for Multimedia Systems, Types of Medium (Perception Media, Representation Media, Presentation Media, Storage Media, Transmission Media, Information Exchange Media), Interaction Techniques.		
II	Multimedia Types, File Formats and Compression Techniques	Digital Image: Representation (2D format, resolution), Types of Images (monochrome, gray, color), File formats like BMP, JPG, Compression Techniques: fundamentals (coding, interpixel and psychovisual redundancies), Types –lossless and lossy, Lossless Compression; Algorithms– Shannon-Fano, CCITT Group 4 2D, Lossy Compression Algorithm – JPEG. Digital Audio: Computer representation of sound, File Formats – WAV, MPEG Audio, Compression: PCM, DM, DPCM. Digital Video: Digitization of Video, types of video signals (component, composite and S-video), File Formats: MPEG Video, H.261, Compression: MPEG Early stopping, Data Augmentation, Adding noise to input and output.	10	CO2
III	Multimedia Authoring and Security	Authoring System: Overview, Introduction to Authoring Tools, Features of Authoring Tools, Design Issue of Multimedia Authoring, Types of Authoring Systems. Digital Watermarking: Concept, Visible and Invisible Watermarks, Watermarking Classification (Spatial Domain, Transform Domain, Feature Domain), Digital Watermarking Applications. Steganography: Concept and Types Image Authentication: Issues and Digital Signature Based Image Authentication.	06	CO3
IV	Introduction to Virtual Reality	Definition of Virtual Reality (VR), Classical Components of VR System, Important Factors in a VR System, Types of VR Systems, VR Advantages, VR Input Output Devices, Applications of VR System.	4	CO4
V	VR Rendering Pipeline	Graphical Rendering Pipeline, Haptic Rendering Pipeline, OpenGL Rendering Pipeline, Geometric Modelling,	06	CO5

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	and Modelling	Kinematic Modelling, Physical Modelling, Behavior Modelling		
VI	VR Programm ing	VRML, Extensible 3D (X3D), Java 3D, OpenGL	06	CO6
Total			39	

Text Books:

1. Prabhat K. Andleigh&KiranThakrar, “Multimedia System Design”, Pearson, 2015.
2. Rajesh K. Maurya, “Computer Graphics with Virtual Reality Systems”, 3rd Edition, Wiley, 2018.
3. K.R.Rao,D.Milovanovic, Multimedia Communication Systems: Techniques, Standards and Networks, Pearson, 2012.
4. Koegel Buford, “Multimedia Systems”, Pearson, 2002.

References:

1. Steinmetz Ralf and NahrstedtKlara, “Multimedia: Computing, Communications and Applications”, Pearson, 2008.
2. AtulPuri, “Multimedia Systems, Standards, and Networks”, 1st Edition, CRC Press, 2000.
3. Frank Y. Shih, “Multimedia Security: Watermarking, Steganography and Forensics”, CRC Press, 2013.
4. Grigore C. Burdea, Philippe Coiffet, “Virtual Reality Technology”, 2nd Edition, Wiley, 2003.
5. John Vince, “Virtual Reality Systems”, Pearson, 2002.

Online references:

Sr. No.	Website Name
1.	Multimedia Systems: https://nptel.ac.in/courses/117105083

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2.	Virtual Reality: https://nptel.ac.in/courses/106106138
3.	Virtual Reality Specialization: https://www.coursera.org/specializations/virtual-reality

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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC833	Quantum Computing	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC833	Quantum Computing	20	20	40	60	2.5	--	--	100

Rationale

Quantum Computing introduces students to a new computing paradigm based on quantum mechanics, offering solutions to problems beyond the reach of classical systems. The subject covers key concepts like qubits, superposition, entanglement, and quantum algorithms, with hands-on experience using quantum simulators and platforms. It prepares students for emerging careers and research in fields such as cryptography, optimization, and AI, fostering interdisciplinary learning and innovation.

Course Objectives:

1. To understand basics of quantum computing
2. To understand mathematics required for quantum computing.
3. To understand building blocks of quantum computing.



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4. To understand quantum algorithms.
5. To understand quantum hardware principles.
6. To understand tools for quantum computing. To introduce students about basic fundamentals and key aspects of the multimedia system.

Course Outcomes:

1. Explain basic concepts of quantum computing
2. Explain mathematical fundamentals required for quantum computing.
3. Explain building blocks of quantum computing through architecture and programming models.
4. Explain quantum algorithms.
5. Explain quantum hardware building principles.
6. Explain usage of tools for quantum computing. Understand the basics of multimedia and multimedia system architecture.

Prerequisite: Digital System Design Engineering ,Mathematics-III ,Data Structures and Algorithm

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.)	7	CO1



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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
III	Building Blocks for Quantum Program	Architecture of a Quantum Computing platform Details of q-bit system of information representation: Block Sphere Multi-qubpits Stateys Quantum - superposAition of qpubits (vralid aind linvalid 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
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, University of Mumbai (B.E. Electronics and Computer Science) Page 103 of 140 Trapped Ion Qubits, Mølmer-Sørensen Coupling .	10	CO5



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		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.		
VI	OSS Toolkits for implementing Quantum program	IBM quantum experience Microsoft Q Rigetti PyQuil (QPU/QVM)	03	CO6
Total			39	

Text Books:

1. Michael A. Nielsen, "Quantum Computation and Quantum Information", Cambridge University Press.
2. David McMahon, "Quantum Computing Explained", Wiley, 2008
3. Vladimir Silva, Practical Quantum Computing for Developers, 2018
4. Bernard Zygelman, A First Introduction to Quantum Computing and Information, 2018
5. Supriyo Bandopadhyay and Marc Cahy, "Introduction to Spintronics", CRC Press, 2008.

References:

- 1 The Second Quantum Revolution: From Entanglement to Quantum Computing and Other Super-Technologies, Lars Jaeger
2. La Guardia, Giuliano Gladioli "Quantum Error correction codes" Springer,

Online references:

Sr. No.	Website Name
1.	https://qiskit.org/textbook-beta/
2.	https://nptel.ac.in/courses/106106232
3.	https://onlinecourses.nptel.ac.in/noc21_cs103/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECC834	System Security	3	-	-	3	-	-	3

Course Code	Course Name	Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		IAT 1	IAT 2	Total					
ECC834	System Security	20	20	40	60	2.5	--	--	100

Rationale:

The rationale of system security is to protect information systems and the data they contain from unauthorized access, use, disclosure, disruption, modification, or destruction. It's a crucial practice for maintaining the confidentiality, integrity, and availability of sensitive information and ensuring the proper functioning of systems.

Course Objectives:

1. To understand the fundamentals of system security.
2. To explore the working principles and utilities of various crypto algorithms including Secret key Cryptography and public key algorithms
3. To understand the various controls available for protection against internet attacks, including integrity check, firewalls, intruder detection systems.
4. To understand, and evaluate different attacks on Open Web Applications and Web services
5. To describe the mechanisms used to provide security in different infrastructure

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and networks.

6. To perform Security Auditing and Analysis

Course Outcomes:

1. Understand the concept of vulnerabilities, attacks and protection mechanisms.
2. Understand the working of various crypto algorithms.
3. Analyze various controls available for protection against internet attacks.
4. Evaluate different attacks on Open Web Applications and Web services
5. Analyze mechanisms used to provide security in different infrastructure and networks
6. Perform security monitoring and testing of system

Prerequisite:

Computer Networks

DETAILED SYLLABUS:

Sr. No.	Name of Module	Detailed Content	Hours	CO Mapping
0	Prerequisite	Computer Networks		
I	The Need for System Security	1.1 Risks, Threats, and Vulnerabilities, Tenets of Information Systems Security (Confidentiality, Integrity, Availability) 1.2 Malicious Attack Birthday Attacks, Brute-Force Password Attacks, Dictionary Password Attacks, IP Address Spoofing Hijacking, Replay Attacks, Man-in-the-Middle Attacks Masquerading, Eavesdropping, Social	4	CO1

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		Engineering, Phreaking, Phishing, Pharming		
II	Cryptography	2.1 Cryptography: Overview of Cryptography: What is cryptography, encryption and decryption techniques, Symmetric and asymmetric key cryptography: AES, DES, RSA, Knapsack crypto system.	6	CO2
III	Network Security	3.1 Firewall: Need of Firewall, types of firewall- Packet Filters, Stateful Packet Filters, Application Gateways, Circuit gateways. Firewall Policies, Configuration, limitations, DMZ, VPN. 3.2 Intrusion Detection System Vulnerability Assessment, Misuse detection, Anomaly Detection, Network Based IDS, Host-Based IDS, Honeypots 3.3 Kerberos: Working, AS, TGS, SS 3.4 IP Security-Overview, Protocols- AH, ESP, Modes-transport and Tunnel. 3.5 Public key infrastructure Introduction, Certificates, (PKI): Certificate Authority, authority, Registration 3.6 X.509/PKIX certificate format. 3.7 Basic concepts of SNMP, SNMPv1 Community facility and SNMPv3	9	CO3
IV	Web Security	4.1 Web Security Considerations, User Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Privacy on Web, Web Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, Cross Site Request Forgery, Session Hijacking and	7	CO4

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		Management, Secure Electronic Transaction, Email Attacks, DNS Attacks, Web Service Security.		
V	Infrastructure Security	5.1 Physical Security: Managerial, Technical And Physical Controls, Environmental Exposures And Controls, Physical Access Controls 5.2 Wireless network Security: IEEE 802.11xWireless LAN Security, Wireless Intrusion Detection System (WIDS) 5.3 Mobile Security: Security Threats, Device Security, Cloud Security: Cloud Security Risks and Countermeasures, Cloud Identity and Access Management, Cloud Security as a Service, SAML, OAuth 5.4 IOT Security: IoT Concepts, IoT Attacks, IoT Hacking Methodology, IoT Hacking Tools, IoT Countermeasures	9	CO5
VI	Security Auditing and Analysis	How to define your audit plan? What auditing benchmarks are? How to collect audit data? Which post-audit activities you need to perform? How to perform security monitoring? Which types of log information you should capture? How to verify security controls? How to monitor and test your security systems?	4	CO6

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Text Books:

- 1 Computer Security Principles and Practice, William Stallings, Sixth Edition, Pearson Education
2. Security in Computing, Charles P. Pfleeger, Fifth Edition, Pearson Education .
3. Fundamentals of Information system security, Third Edition, David Kim, Michael G. Solomon, Jones & Bartlett Learning
4. Network Security and Cryptography, Bernard Menezes, Cengage Learning
5. Network Security Bible, Eric Cole, Second Edition, Wiley

References:

1. Web Application Hackers Handbook by Wiley.
2. Information Security The Complete Reference, 2nd Edition, Mark Rhodes-Ousley, McGraw Hill Education
3. Computer Security, Dieter Gollman, Third Edition, Wiley
4. CCNA Security Study Guide, Tim Boyle, Wiley
5. Introduction to Computer Security, Matt Bishop, Pearson.
6. Cloud Security and Privacy, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly

Online References:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc22_cs88/preview



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Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL805	Robotics 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	Total				
ECL805	Robotics lab	--	--	--	--	25	25	50

Lab Objectives:

1. To understand the mechanical structure and degrees of freedom of robotic arms.
- 2 To derive and compute the position of the end-effector using forward kinematics.
- 3 To differentiate between joint-space and Cartesian-space trajectories.
- 4 To understand and implement template matching in object detection.
- 5 To implement basic iterative control logic using software.
- 6 To integrate kinematics, trajectory planning, and vision for solving a real-world task.

Lab Outcomes:

1. Demonstrate the working principles of 4-axis and 5-axis robotic arms.

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2. Solve forward and inverse kinematics problems for robotic manipulators.
3. Implement joint-space and Cartesian-space trajectory planning.
4. Apply computer vision techniques such as template matching and segmentation for robotic perception.
5. Analyze the role of iterative processing in robot control algorithms.
6. Design and develop a mini-project using robotic and perception systems.

List of Experiments.

Sr No	List of Experiments	LO mapping	Hrs
01	Study/Demo of 4 axis robotic arm	LO1	02
02	Study/Demo of 5 axis robotic arm	LO1	
03	Forward kinematic	LO2	
04	Inverse kinematic	LO2	
05	Joint-space trajectory	LO3	
06	Cartesian-space trajectory	LO3	
07	Template matching	LO4	
08	Iterative processing	LO5	
09	Segmentation	LO4	
10	Mini project	LO6	

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Sr No	List of Assignments / Tutorials	Hrs
01	Study of Robot Types, Kinematics, and Workspace Analysis	02
02	Trajectory Planning, Task Execution, and Vision-Based Control in Robotics	02

Text Books:

1. Robert Shilling, “Fundamentals of Robotics - Analysis and control, Prentice Hall of India, 2009
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition, 2011

References:

1. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India, 2009
2. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd., 2006
3. Mikell P. Groover et.al, ”Industrial Robots-Technology, Programming & applications”, McGraw Hill , New York, 2008
5. S. R. Deb and Sankha Deb, “Robotics Technology and Flexible Automation” , Second Edition. TMH

Assessment:

Term Work: Term work consists of performing minimum 6 experiments covering entire syllabus of Robotics, one mini project and two 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
ECL861	MEMS Technology 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	Total				
ECL861	MEMS Technology Lab	--	--	--	--	25	25	50

Lab Objectives:

1. Understand the fundamental principles of MEMS-based devices through simulation of mechanical, thermal, and electrical behavior.
2. Model cantilever beams, pressure sensors, accelerometers, and actuators using simulation tools such as COMSOL Multiphysics or ANSYS.
3. Simulate the behavior of smart materials like Shape Memory Alloys (SMA) and Piezoelectric materials in sensor and actuator applications.
4. Perform thermal and structural analysis of MEMS-based thermal actuators.
5. Analyze and interpret experimental results from hardware-based MEMS setups.
6. Investigate recent advances in MEMS technology through case studies and literature reviews.

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Lab Outcomes:

By the end of this course, students will be able to:

1. Demonstrate modeling and simulation of a cantilever beam and identify its resonance behavior. (Apply)
2. Simulate pressure sensors and analyze sensitivity under varying environmental conditions. (Analyze)
3. Design and validate the performance of MEMS-based accelerometers using simulation tools. (Create)
4. Evaluate thermal behavior and displacement of MEMS thermal actuators. (Evaluate)
5. Conduct hardware testing of MEMS devices and interpret sensor response. (Apply, Analyze)
6. Prepare a case study report on a recent advancement or innovation in MEMS technology. (Create, Evaluate)

List of Experiments.

Sr No	List of Experiments	Hrs
01	Modeling and simulation of cantilever .	2
02	Modeling and simulation of pressure sensor .	2
03	Modeling and simulation of accelerometer .	
04	Modeling and simulation of thermal actuator. .	2
05	Modeling and simulation of SMA .	2
06	Modeling and simulation of Piezoelectric sensor. .	2
07	Hardware experiment on MEMS devices.	2
08	Hardware experiment on MEMS devices	2

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09	Case study on advance topic.	2
10	Case study of recent development in the subject.	2

Sr No	List of Assignments / Tutorials	Hrs
01	Case study on any MEMS device	2
02	Review paper writing on advance topic.	2

Text Books:

1. An Introduction to Micro-Electromechanical Systems Engineering; 2nd Ed - by N. Maluf, K Williams; Publisher: Artech House Inc.
2. Micro-system Design - by S. Senturia; Publisher: Springer.
3. Introduction to Electromechanical system design –by James J Allen. Taylor & Francis Group, LLC publication

Reference Books:

1. Fundamentals of Micro-fabrication - by M. Madou; Publisher: CRC Press; 2nd edition.
2. Micro machined Transducers Sourcebook - by G. Kovacs; Publisher: McGraw-Hill4.

Online Resources:

Sr. No.	Website Name
1.	Refer to review papers in IEEE Journal of Microelectromechanical Systems.

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.

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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
ECL 862	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	TOTAL				
ECL862	Natural Language Processing Lab	--	--	--	--	25	25	50

Lab Objectives:

1. To implement text preprocessing techniques such as tokenization, filtration, script validation, stop word removal, and stemming.
2. To analyze the morphological structure of words using Add-Delete tables for better understanding of root word derivation.
3. To understand and apply statistical language modeling techniques using N-gram models.



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4. To implement Parts of Speech (POS) tagging using rule-based and statistical approaches.
5. To compute emission and transition probabilities and apply the Hidden Markov Model (HMM) for POS tagging.
6. To develop and evaluate models for Chunking and Named Entity Recognition (NER) using tagged corpora.

Lab Outcomes:

1. Apply standard NLP preprocessing methods including tokenization, stop word removal, and stemming.
2. Validate and clean input text using script normalization techniques and understand their importance in multilingual NLP.
3. Construct and use Add-Delete tables for morphological analysis and root word extraction.
4. Build and evaluate N-gram language models and use them for predictive text generation and probability estimation.
5. Implement POS tagging using HMM and Viterbi decoding by calculating emission and transition probabilities.
6. Identify syntactic patterns using chunking and extract named entities using NER techniques.

List of Experiments.

Sr No	List of Experiments	Hrs
01	Preprocessing of text (Tokenization, Filtration)	2
02	Preprocessing of text (Script Validation)	2
03	Preprocessing of text (Stop Word Removal, Stemming)	2
04	Understanding the morphology of a word by the use of the Add-Delete table.	2



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05	N-gram model	2
06	POS tagging	2
07	Calculation of emission and transition matrix which will be helpful for tagging Parts of Speech using Hidden Markov Model.	2
08	Find POS tags of words in a sentence using Viterbi decoding.	2
09	Chunking	2
10	Named Entity Recognition	2

Text Books:

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

References:

1. Steven Bird, Ewan Klein, Natural Language Processing with Python, O'Reilly
2. Alexander Clark (Editor), Chris Fox (Editor), Shalom Lappin (Editor), The Handbook of Computational

Online Resources:

Sr. No.	Website Name
1.	https://onlinecourses.nptel.ac.in/noc23_cs45/preview
2.	https://www.coursera.org/specializations/natural-language-processing

Assessment:

Term Work: Term Work shall consist of at least 8 practical's based on the above list. Also, Term work Journal must include at least 2 assignments.



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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
ECL863	3-D Printing and Design 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	TOTAL				
ECL863	3-D Printing and Design Lab	--	--	--	--	25	25	50

Rational:

The 3D Printing and Design Lab offers practical exposure to digital modeling and additive manufacturing processes. It enables students to design, prototype, and fabricate components using CAD tools and 3D printers. This hands-on experience fosters innovation and prepares learners for careers in product design, engineering, and rapid prototyping.

Lab Objectives:

1. Understand the operational workflow of various 3D printing technologies.
2. Develop digital 3D models using CAD tools.
3. Slice 3D models and configure printer settings for optimal output.



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4. Fabricate physical prototypes from digital designs.
5. Evaluate printed models for dimensional accuracy and structural integrity.
6. Integrate design thinking principles to address real-world and SDG-aligned problems.

Lab Outcomes:

On successful completion of the course learner will be able to:

1. Identify components and working of various types of 3D printers
2. Create CAD models for 3D printing using design software
3. Slice and simulate digital designs with correct printer settings
4. Operate a 3D printer and fabricate a physical model
5. Test and evaluate printed models for quality and errors
6. Apply design thinking to solve sustainable development problems

List of Experiments.

Sr No	List of Experiments	Hrs
01	Study of different 3D printing technologies and their working principles	
02	Introduction to 3D Printer hardware and software (FDM/Resin printer setup)	
03	Create basic CAD models using Tinkercad / Fusion 360 / FreeCAD	
04	Design a parametric model using OpenSCAD	
05	Import CAD model into slicer (Ultimaker Cura/PrusaSlicer), generate G-code	
06	Calibrate and operate a 3D printer to print a basic mechanical part	
07	Print a 3D model from STL file (e.g., keychain or mobile holder)	
08	Design and fabricate a sustainable product prototype (e.g., water-saving tap nozzle, prosthetic part)	



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09	Troubleshoot 3D print failures (layer shifting, under/over extrusion, warping)	
10	Dimensional accuracy and tolerance check on printed models using calipers	

Sr No	List of Assignments / Tutorials	Hrs
01	ASSIGNMENT 1: 1. Write a comparative report on FDM vs SLA vs SLS printing techniques. (SDG 9 – Industry Innovation) 2. Case study: How 3D printing contributed to COVID-19 medical supplies. (SDG 3 – Good Health & Wellbeing)	3
02	ASSIGNMENT 2: 1. Prepare a research note on sustainable materials for 3D printing. (SDG 12 – Responsible Consumption) 2. Design a 3D-printed product to solve a real-world problem in rural India. 3. Analyze the cost of in-house 3D printing vs outsourced rapid prototyping.	3

Text Books:

1. Chua Chee Kai, Kah Fai Leong, Chu Sing Lim – "Rapid Prototyping: Principles and Applications", World Scientific Publishing.
2. Ian Gibson, David Rosen, Brent Stucker – "Additive Manufacturing Technologies", Springer.
3. Ben Redwood, Filemon Schöffner, Brian Garrett – "The 3D Printing Handbook", 3D Hubs.

References:

- 1) Ben Redwood, Filemon Schöffner, Brian Garret – "The 3D Printing Handbook: Technologies, Design and Applications", 3D Hubs.
- 2) Andreas Bastian – "Design for Additive Manufacturing: Concepts and Applications", MIT Additive Manufacturing Center (Online Resource).



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Online Resources:

Sr. No.	Website Name
1.	Free CAD Software: www.tinkercad.com
2.	Free Courses: nptel.ac.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)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL864	Advanced Algorithms 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	TOTAL				
ECL 864	Advanced Algorithms Lab	--	--	--	--	25	25	50

Lab Objectives:

1. **Understand and implement advanced algorithmic techniques** such as Divide and Conquer, Greedy Algorithms, Dynamic Programming, and Backtracking.

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2. **Analyze the time and space complexity** of algorithms using theoretical and empirical methods.
3. **Solve real-world computational problems** by applying appropriate algorithmic strategies.
4. **Develop proficiency in writing efficient, optimized code** for complex algorithmic problems.
5. **Explore graph algorithms** such as shortest path, minimum spanning tree, and maximum flow in practical scenarios.

Lab Outcomes:

1. Understand the methods of designing and analyzing algorithms.
2. Design and implement efficient algorithms for a specified application.
3. Strengthen the ability to identify and apply the suitable algorithm for the given real-world problem.
4. Analyze worst-case running time of algorithms and understand fundamental algorithmic problems.



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List of Experiments.

Sr No	List of Experiments	Hrs
01	Implementation of Merge and Quick sort using divide and conquer approach	
02	Implementation of Fractional Knapsack	
03	Implementation of Dijkstra's algorithms	
04	Implementation of 0/1 Knapsack using dynamic programming	
05	Implementation of Longest Common Subsequence	
06	Implementation of Floyd's Warshall's algorithm	
07	Implementation of Ford Fulkerson algorithm	
08	Implementation of Maximum Bipartite matching algorithm	
09	Implementation of n-queen using backtracking	
10	Implementation of sum of subsets algorithm	
11	Implementation of 15 puzzle problem	
12	Implementation of Travelling salesman's problem	

Text Books:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, The MIT Press, 2009.
2. Michael T Goodrich and Roberto Tamassia, "Algorithm Design: Foundations, Analysis and Internet Examples", John Wiley and Sons, 2002.
3. Sanjoy Dasgupta, Christos Papadimitriou and Umesh Vazirani, "Algorithms", Tata McGraw-Hill, 2009
4. R.K. Ahuja, TL Magnanti and JB Orlin, "Network flows: Theory, Algorithms, and

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Applications”, PrenticeHall Englewood Cliffs, NJ 1993.

References:

1. M.R. Garey and D.S. Johnson, Computers and Intractability: A Guide to the Theory of NP-Completeness, Freeman, 1979.
2. E. Horowitz and S. Sahni, Fundamentals of Computer Algorithms, Computer Science Press, 1978.

Online Resources:

Sr. No.	Website Name
1.	NPTEL course: https://nptel.ac.in/courses/106105164
2.	Coursera link: https://www.coursera.org/specializations/algorithms

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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Subject code	Subject Name	Teaching scheme			Credit assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
ECL807	Major Project – II	--	8 [#]	--	--	4	--	4

Indicates workload of Learner (Not Faculty)

Sub Code	Subject Name	Examination scheme							
		Theory (out of 100)				Term work	Pract. and Oral	Oral	Total
		Internal Assessment			End sem Exam				
		IAT 1	IAT 2	Avg.					
ECL807	Major Project – II	--	--	--	--	50	100	--	150

Subject Code	Subject Name	Credits
ECL807	Major Project – II	4
Course Objectives	The course is aimed 1. To acquaint with the process of identifying the needs and converting it into the problem. 2. To familiarize the process of solving the problem in a group. 3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems. 4. To inculcate the process of self-learning and research.	

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Course Outcomes	On successful completion of course learner/student will be able to: 1. Identify problems based on societal /research needs. 2. Apply Knowledge and skill to solve societal problems in a group. 3. Develop interpersonal skills to work as member of a group or leader. 4. Draw the proper inferences from available results through theoretical/ experimental/simulations. 5. Analyze the impact of solutions in societal and environmental context for sustainable development. 6. Use standard norms of engineering practices 7. Excel in written and oral communication. 8. Demonstrate capabilities of self-learning in a group, which leads to lifelong learning. 9. Demonstrate project management principles during project work.

Guidelines for Major Project

- Students should form groups with minimum 2(two) and not more than 4 (four)
- Students should do survey and identify needs, which shall be converted into problem statement for major project in consultation with faculty supervisor/head of department/internal committee of faculties.
- Student shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of major project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during major project activity; however, focus shall be on self-learning.

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- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the major Projects.

Guidelines for Assessment of

Major Project: Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of major project to be evaluated on continuous basis, minimum two reviews in the 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;
 - o Marks awarded by guide/supervisor based on log book : 30
 - o Marks awarded by review committee : 30
 - o Quality of Project report : 40

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Review/progress monitoring committee may consider following points for assessment.

- In VIII semester expected work shall be procurement of component's/systems, building of working prototype, testing and validation of results based on work completed in _____ an _____ earlier _____ semester.
- First review is based on readiness of building working prototype to be conducted.
- Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Assessment criteria of Major Project-II

Major Project-II shall be assessed based on following criteria;

1. Cost effectiveness and Societal impact
2. Full functioning of working model as per stated requirements
3. Effective use of skill sets
4. Effective use of standard engineering norms
5. Contribution of an individual's as member or leader
6. Clarity in written and oral communication



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Guidelines for Assessment of Major Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Major Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Major Project shall be assessed based on following points:

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individuals as member or leader
8. Clarity in written and oral communication

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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.

OE84WW	Open Elective -2 (Common for all branches will be notified)
OE8401	Project Management
OE8402	Finance Management
OE8403	Entrepreneurship Development and Management
OE8404	Human Resource Management
OE8405	Professional Ethics and CSR
OE8406	Research Methodology
OE8407	IPR and Patenting
OE8408	Digital Business Management
OE8409	Environmental Management

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Course Code	Course Name	Credits
OE8401	Project Management	03

Objectives:

1. To familiarize the students with the use of a structured methodology/approach for each and every unique project undertaken, including utilizing project management concepts, tools and techniques.
2. To appraise the students with the project management life cycle and make them knowledgeable about the various phases from project initiation through closure.

Outcomes: Learner will be able to...

1. Apply selection criteria and select an appropriate project from different options.
2. Write work break down structure for a project and develop a schedule based on it.
3. Identify opportunities and threats to the project and decide an approach to deal with them strategically.
4. Use Earned value technique and determine & predict status of the project.
5. Capture lessons learned during project phases and document them for future reference

Module	Detailed Contents	Hrs
01	Project Management Foundation: Definition of a project, Project Vs Operations, Necessity of project management, Triple constraints, Project life cycles (typical & atypical) Project phases and stage gate process. Role of project manager. Negotiations and resolving conflicts. Project management in various organization structures. PM knowledge Areas as per Project Management Institute (PMI).	5
02	Initiating Projects: How to get a project started, Selecting project strategically, Project selection models (Numeric /Scoring Models and Non-numeric models), Project portfolio process, Project sponsor and creating charter; Project proposal. Effective project team, Stages of team development & growth (forming, storming, norming &	6



	performing), team dynamics.	
03	Project Planning and Scheduling: Work Breakdown structure (WBS) and linear responsibility chart Interface Co-ordination and concurrent engineering, Project cost estimation and budgeting, Top down and bottoms up budgeting, Networking and Scheduling techniques. PERT, CPM, GANTT chart. Introduction to Project Management Information System (PMIS).	8
04	Planning Projects: Crashing project time, Resource loading and leveling, Goldratt's critical chain, Project Stakeholders and Communication plan. Risk Management in projects: Risk management planning, Risk identification and risk register. Qualitative and quantitative risk assessment, Probability and impact matrix. Risk response strategies for positive and negative risks	6
05	Executing Projects: Planning monitoring and controlling cycle. Information needs and reporting, engaging with all stakeholders of the projects. Team management, communication and project meetings. Monitoring and Controlling Projects: Earned Value Management techniques for measuring value of work completed; Using milestones for measurement; change requests and scope creep. Project audit. Project Contracting Project procurement management, contracting and outsourcing,	8
06	Project Leadership and Ethics: Introduction to project leadership, ethics in projects. Multicultural and virtual projects. Closing the Project: Customer acceptance; Reasons of project termination, Various types of project terminations (Extinction, Addition, Integration, Starvation), Process of project termination, completing a final report; doing a lessons learned analysis; acknowledging successes and failures; Project management templates and other resources; Managing without authority; Areas of further study.	6



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2. A Guide to the Project Management Body of Knowledge (PMBOK® Guide), 5th Ed, Project Management Institute PA, USA
3. Gido Clements, Project Management, Cengage Learning.
4. Gopalan, Project Management, , Wiley India
5. Dennis Lock, Project Management, Gower Publishing England, 9th Ed.

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Course Code	Course Name	Credits
OE8402	Finance Management	03

Objectives:

1. Overview of Indian financial system, instruments and market
2. Basic concepts of value of money, returns and risks, corporate finance, working capital and its management
3. Knowledge about sources of finance, capital structure, dividend policy

Outcomes: Learner will be able to...

1. Understand Indian finance system and corporate finance
2. Take investment, finance as well as dividend decisions

Module	Detailed Contents	Hrs
01	Overview of Indian Financial System: Characteristics, Components and Functions of Financial System. Financial Instruments: Meaning, Characteristics and Classification of Basic Financial Instruments — Equity Shares, Preference Shares, Bonds-Debentures, Certificates of Deposit, and Treasury Bills. Financial Markets: Meaning, Characteristics and Classification of Financial Markets Capital Market, Money Market and Foreign Currency Market Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions — Commercial Banks, Investment-Merchant Banks and Stock Exchanges	06



02	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio; Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio. Time Value of Money: Future Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Present Value of a Lump Sum, Ordinary Annuity, and Annuity Due; Continuous Compounding and Continuous Discounting.	06
03	Overview of Corporate Finance: Objectives of Corporate Finance; Functions of Corporate Finance—Investment Decision, Financing Decision, and Dividend Decision. Financial Ratio Analysis: Overview of Financial Statements—Balance Sheet, Profit and Loss Account, and Cash Flow Statement; Purpose of Financial Ratio Analysis; Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	09
04	Capital Budgeting: Meaning and Importance of Capital Budgeting; Inputs for Capital Budgeting Decisions; Investment Appraisal Criterion—Accounting Rate of Return, Payback Period, Discounted Payback Period, Net Present Value(NPV), Profitability Index, Internal Rate of Return (IRR), and Modified Internal Rate of Return (MIRR) Working Capital Management: Concepts of Meaning Working Capital; Importance of Working Capital Management; Factors Affecting an Entity's Working Capital Needs; Estimation of Working Capital Requirements; Management of Inventories; Management of Receivables; and Management of Cash and Marketable Securities	10
05	Sources of Finance: Long Term Sources—Equity, Debt, and Hybrids; Mezzanine Finance; Sources of Short Term Finance—Trade Credit, Bank Finance, Commercial Paper; Project Finance. Capital Structure: Factors Affecting an Entity's Capital Structure; Overview of Capital Structure Theories and Approaches— Net Income Approach, Net Operating Income Approach; Traditional Approach, and Modigliani-Miller Approach. Relation between Capital Structure and Corporate Value; Concept of	05



	Optimal Capital Structure	
06	Dividend Policy: Meaning and Importance of Dividend Policy; Factors Affecting an Entity's Dividend Decision; Overview of Dividend Policy Theories and Approaches— Gordon's Approach, Walter's Approach, and Modigliani-Miller Approach	03

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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.



Course Code	Course Name	Credits
OE8403	Entrepreneurship Development and Management	03

Objectives:

1. To acquaint with entrepreneurship and management of business
2. Understand Indian environment for entrepreneurship
3. Idea of EDP, MSME

Outcomes: Learner will be able to...

1. Understand the concept of business plan and ownerships
2. Interpret key regulations and legal aspects of entrepreneurship in India
3. Understand government policies for entrepreneurs

Module	Detailed Contents	Hrs
01	Overview Of Entrepreneurship: Definitions, Roles and Functions/Values of Entrepreneurship, History of Entrepreneurship Development, Role of Entrepreneurship in the National Economy, Functions of an Entrepreneur, Entrepreneurship and Forms of Business Ownership Role of Money and Capital Markets in Entrepreneurial Development: Contribution of Government Agencies in Sourcing information for Entrepreneurship	04
02	Business Plans And Importance Of Capital To Entrepreneurship: Preliminary and Marketing Plans, Management and Personnel, Start-up Costs and Financing as well as Projected Financial Statements, Legal Section, Insurance, Suppliers and Risks, Assumptions and Conclusion, Capital and its Importance to the Entrepreneur Entrepreneurship And Business Development: Starting a New Business, Buying an Existing Business, New Product Development, Business Growth and the Entrepreneur Law and its Relevance to Business Operations	09



03	Women's Entrepreneurship Development, Social entrepreneurship-role and need, EDP cell, role of sustainability and sustainable development for SMEs, case studies, exercises	05
04	Indian Environment for Entrepreneurship: key regulations and legal aspects , MSMED Act 2006 and its implications, schemes and policies of the Ministry of MSME, role and responsibilities of various government organisations, departments, banks etc., Role of State governments in terms of infrastructure developments and support etc., Public private partnerships, National Skill development Mission, Credit Guarantee Fund, PMEGP, discussions, group exercises etc	08
05	Effective Management of Business: Issues and problems faced by micro and small enterprises and effective management of M and S enterprises (risk management, credit availability, technology innovation, supply chain management, linkage with large industries), exercises, e-Marketing	08
06	Achieving Success In The Small Business: Stages of the small business life cycle, four types of firm-level growth strategies, Options – harvesting or closing small business Critical Success factors of small business	05

REFERENCES:

1. Poornima Charantimath, Entrepreneurship development- Small Business Enterprise, Pearson
2. Education Robert D Hisrich, Michael P Peters, Dean A Shapherd, 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
6. Maddhurima Lall, Shikah Sahai, Entrepreneurship, Excel Books
7. Rashmi Bansal, STAY hungry STAY foolish, CIIE, IIM Ahmedabad
8. Law and Practice relating to Micro, Small and Medium enterprises,



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9. Kurakto, Entrepreneurship- Principles and Practices, Thomson Publication
10. Laghu Udyog Samachar
11. www.msme.gov.in
12. www.dcmesme.gov.in
13. www.msmetraining.gov.in



Course Code	Course Name	Credits
OE8404	Human Resource Management	03

Objectives:

1. To introduce the students with basic concepts, techniques and practices of the human resource management.
2. To provide opportunity of learning Human resource management (HRM) processes, related with the functions, and challenges in the emerging perspective of today's organizations.
3. To familiarize the students about the latest developments, trends & different aspects of HRM.
4. To acquaint the student with the importance of inter-organizational setting required for future stable engineers, leaders and managers.

Outcomes: Learner will be able to...

1. Understand the concepts, aspects, techniques and practices of the human resource management.
2. Understand the Human resource management (HRM) processes, functions, changes and challenges in today's emerging organizational perspective.
3. Gain knowledge about the latest developments and trends in HRM.
4. Apply the knowledge of behavioral skills learnt and integrate it with in inter personal and intergroup environment emerging as future stable engineers and managers.

Module	Detailed Contents	Hrs
01	Introduction to HR Human Resource Management- Concept, Scope and Importance, Interdisciplinary Approach Relationship with other Sciences, Competencies of HR Manager, HRM functions. Human resource development (HRD): changing role of HRM – Human resource Planning, Technological change, Restructuring and rightsizing, Empowerment, TQM, Managing ethical issues.	5



02	Organizational Behavior (OB) Introduction to OB Origin, Nature and Scope of Organizational Behavior, Relevance to Organizational Effectiveness and Contemporary issues Personality: Meaning and Determinants of Personality, Personality development, Personality Types, Assessment of Personality Traits for Increasing Self Awareness Perception: Attitude and Value, Effect of perception on Individual Decision-making, Attitude and Behavior. Motivation: Theories of Motivation and their Applications for Behavioral Change (Maslow, Herzberg, McGregor); Group Behavior and Group Dynamics: Work groups formal and informal groups and stages of group development. Team Effectiveness. High performing teams, Team Roles, cross functional and self-directed team.	7
03	Organizational Structure & Design Structure, size, technology, Environment of organization. Organizational Roles & conflicts: Concept of roles; role dynamics; role conflicts and stress. Leadership: Concepts and skills of leadership, Leadership and managerial roles, Leadership styles and contemporary issues in leadership. Power and Politics: Sources and uses of power; Politics at workplace. Tactics and strategies.	6
04	Human resource Planning Recruitment and Selection process, Job-enrichment, Empowerment - Job- Satisfaction, employee morale. Performance Appraisal Systems: Traditional & modern methods Performance Counseling, Career Planning. Training & Development: Identification of Training Needs, Training Methods	5
05	Emerging Trends in HR Organizational development; Business Process Re-engineering (BPR), BPR as a tool for organizational development , managing processes & transformation in HR. Organizational Change, Culture, Environment Cross Cultural Leadership and Decision Making: Cross Cultural Communication and diversity at work, Causes of diversity, managing diversity with special reference to handicapped, women and ageing people, intra company cultural difference in employee motivation.	6
	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	



06	Role of Strategic HRM in the modern business world, Concept of Strategy, Strategic Management Process, Approaches to Strategic Decision Making; Strategic Intent – Corporate Mission, Vision, Objectives and Goals Labor Laws & Industrial Relations Evolution of IR, IR issues in organizations, Overview of Labor Laws in India; Industrial Disputes Act, Trade Unions Act, Shops and Establishments Act	10

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1. Stephen Robbins, Organizational Behavior, 16th Ed, 2013
2. V S P Rao, Human Resource Management, 3rd Ed, 2010, Excel publishing
3. Aswathapa, Human resource management: Text & cases, 6th edition, 2011
4. C. B. Mamoria and S V Gankar, Dynamics of Industrial Relations in India, 15th Ed, 2015, Himalaya Publishing, 15th edition, 2015
5. P. Subba Rao, Essentials of Human Resource management and Industrial relations, 5th Ed, 2013, Himalaya Publishing
6. Laurie Mullins, Management & Organizational Behavior, Latest Ed, 2016, Pearson Publications



Course Code	Course Name	Credits
OE8405	Professional Ethics and Corporat Social Responsibility (CSR)	03

Objectives:

1. To understand professional ethics in business
2. To recognized corporate social responsibility

Outcomes: Learner will be able to...

1. Understand rights and duties of business
2. Distinguish different aspects of corporate social responsibility
3. Demonstrate professional ethics
4. Understand legal aspects of corporate social responsibility

Module	Detailed Contents	Hrs
01	Professional Ethics and Business: The Nature of Business Ethics; Ethical Issues in Business; Moral Responsibility and Blame; Utilitarianism: Weighing Social Costs and Benefits; Rights and Duties of Business	04
02	Professional Ethics in the Marketplace: Perfect Competition; Monopoly Competition; Oligopolistic Competition; Oligopolies and Public Policy Professional Ethics and the Environment: Dimensions of Pollution and Resource Depletion; Ethics of Pollution Control; Ethics of Conserving Depletable Resources	08
03	Professional Ethics of Consumer Protection: Markets and Consumer Protection; Contract View of Business Firm's Duties to Consumers; Due Care Theory; Advertising Ethics; Consumer Privacy Professional Ethics of Job Discrimination: Nature of Job Discrimination; Extent of Discrimination; Reservation of Jobs.	06
04	Introduction to Corporate Social Responsibility: Potential Business Benefits—Triple bottom line, Human resources, Risk management, Supplier relations; Criticisms and concerns—Nature of business; Motives; Misdirection. Trajectory of Corporate Social Responsibility in India	05



05	Corporate Social Responsibility: Articulation of Gandhian Trusteeship Corporate Social Responsibility and Small and Medium Enterprises (SMEs) in India, Corporate Social Responsibility and Public-Private Partnership (PPP) in India	08
06	Corporate Social Responsibility in Globalizing India: Corporate Social Responsibility Voluntary Guidelines, 2009 issued by the Ministry of Corporate Affairs, Government of India, Legal Aspects of Corporate Social Responsibility—Companies Act, 2013.	08

REFERENCES:

1. Business Ethics: Texts and Cases from the Indian Perspective (2013) by Ananda Das Gupta; Publisher: Springer.
2. Corporate Social Responsibility: Readings and Cases in a Global Context (2007) by Andrew Crane, Dirk Matten, Laura Spence; Publisher: Routledge.
3. Business Ethics: Concepts and Cases, 7th Edition (2011) by Manuel G. Velasquez; Publisher: Pearson, New Delhi.
4. Corporate Social Responsibility in India (2015) by BidyutChakrabarty, Routledge, New Delhi.



Course Code	Course Name	Credits
OE8406	Research Methodology	03

Objectives:

1. To understand Research and Research Process
2. To acquaint students with identifying problems for research and develop research strategies
3. To familiarize students with the techniques of data collection, analysis of data and interpretation

Outcomes: Learner will be able to...

1. Prepare a preliminary research design for projects in their subject matter areas
2. Accurately collect, analyze and report data
3. Present complex data or situations clearly
4. Review and analyze research findings

Module	Detailed Contents	Hrs
01	Introduction and Basic Research Concepts Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, Principle. Research methods vs Methodology Need of Research in Business and Social Sciences Objectives of Research Issues and Problems in Research Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical	09
02	Types of Research Basic Research Applied Research Descriptive Research Analytical Research Empirical Research Qualitative and Quantitative Approaches	07
03	Research Design and Sample Design Research Design – Meaning, Types and Significance Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors	07
04	Research Methodology 4.1 Meaning of Research Methodology 4.2. Stages in Scientific Research Process: • Identification and Selection of Research Problem • Formulation of Research Problem	08



	• 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	
05	Formulating Research Problem 5.1 Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis	04
06	Outcome of Research Preparation of the report on conclusion reached Validity Testing & Ethical Issues Suggestions and Recommendation	04

REFERENCES:

1. Dawson, Catherine, 2002, Practical Research Methods, New Delhi, UBS Publishers Distributors.
2. Kothari, C.R., 1985, Research Methodology- Methods and Techniques, New Delhi, Wiley Eastern Limited.
3. Kumar, Ranjit, 2005, Research Methodology-A Step-by-Step Guide for Beginners, (2nded), Singapore, Pearson Education



Course Code	Course Name	Credits
OE8407	IPR and Patenting	03

Objectives:

1. To understand intellectual property rights protection system
2. To promote the knowledge of Intellectual Property Laws of India as well as International treaty procedures
3. To get acquaintance with Patent search and patent filing procedure and applications

Outcomes: Learner will be able to...

1. understand Intellectual Property assets
2. assist individuals and organizations in capacity building
3. work for development, promotion, protection, compliance, and enforcement of Intellectual Property and Patenting

Module	Detailed Contents	Hr
01	Introduction to Intellectual Property Rights (IPR): Meaning of IPR, Different category of IPR instruments - Patents, Trademarks, Copyrights, Industrial Designs, Plant variety protection, Geographical indications, Transfer of technology etc. Importance of IPR in Modern Global Economic Environment: Theories of IPR, Philosophical aspects of IPR laws, Need for IPR, IPR as an instrument of development	05
02	Enforcement of Intellectual Property Rights: Introduction, Magnitude of problem, Factors that create and sustain counterfeiting/piracy, International agreements, International organizations (e.g. WIPO, WTO) active in IPR enforcement Indian Scenario of IPR: Introduction, History of IPR in India, Overview of IP laws in India, Indian IPR, Administrative Machinery, Major international treaties signed by India, Procedure for submitting patent and Enforcement of IPR at national level etc.	07



03	Emerging Issues in IPR: Challenges for IP in digital economy, e-commerce, human genome,biodiversity and traditional knowledge etc.	05
04	Basics of Patents: Definition of Patents, Conditions of patentability, Patentable and non- patentable inventions, Types of patent applications (e.g. Patent of addition etc), Process Patent and Product Patent, Precautions while patenting, Patent specification Patent claims, Disclosures and non-disclosures, Patent rights and infringement, Method of getting a patent	07
05	Patent Rules: Indian patent act, European scenario, US scenario, Australia scenario, Japan scenario, Chinese scenario, Multilateral treaties where India is a member (TRIPS agreement, Paris convention etc.)	08
06	Procedure for Filing a Patent (National and International): Legislation and Salient Features, Patent Search, Drafting and Filing Patent Applications, Processing of patent, Patent Litigation, Patent Publicationetc, Time frame and cost, Patent Licensing, Patent Infringement Patent databases: Important websites, Searching international databases	07



REFERENCE BOOKS:

1. Rajkumar S. Adukia, 2007, A Handbook on Laws Relating to Intellectual Property Rights in India, The Institute of Chartered Accountants of India
2. Keayla B K, Patent system and related issues at a glance, Published by National Working Group on Patent Laws
3. T Sengupta, 2011, Intellectual Property Law in India, Kluwer Law International
4. Tzen Wong and Graham Dutfield, 2010, Intellectual Property and Human Development: Current Trends and Future Scenario, Cambridge University Press
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6. Lous Harns, 2012, The enforcement of Intellactual Property Rights: A Case Book, 3rd Edition, WIPO
7. Prabhuddha Ganguli, 2012, Intellectual Property Rights, 1st Edition, TMH
8. R Radha Krishnan & S Balasubramanian, 2012, Intellectual Property Rights, 1st Edition, Excel Books
9. M Ashok Kumar and mohd Iqbal Ali, 2-11, Intellectual Property Rights, 2nd Edition, Serial Publications
10. Kompal Bansal and Praishit Bansal, 2012, Fundamentals of IPR for Engineers, 1st Edition, BS Publications
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12. Mathew Y Maa, 2009, Fundamentals of Patenting and Licensing for Scientists and Engineers, World Scientific Publishing Company
13. N S Rathore, S M Mathur, Priti Mathur, Anshul Rathi, IPR: Drafting, Interpretation of Patent Specifications and Claims, New India Publishing Agency
14. Vivien Irish, 2005, Intellectual Property Rights for Engineers, IET
15. Howard B Rockman, 2004, Intellectual Property Law for Engineers and scientists, Wiley-IEEE Press

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Course Code	Course Name	Credits
OE8408	Digital Business Management	03

Objectives:

1. To familiarize with digital business concept
2. To acquaint with E-commerce
3. To give insights into E-business and its strategies

Outcomes: The learner will be able to

1. Identify drivers of digital business
2. Illustrate various approaches and techniques for E-business and management
3. Prepare E-business plan

Module	Detailed content	Hours
1	Introduction to Digital Business- Introduction, Background and current status, E-market places, structures, mechanisms, economics and impacts Difference between physical economy and digital economy, Drivers of digital business- Big Data & Analytics, Mobile, Cloud Computing, Social media, BYOD, and Internet of Things(digitally intelligent machines/services) Opportunities and Challenges in Digital Business,	09
2	Overview of E-Commerce E-Commerce- Meaning, Retailing in e-commerce-products and services, consumer behavior, market research and advertisement B2B-E-commerce-selling and buying in private e-markets, public B2B exchanges and support services, e-supply chains, Collaborative Commerce, Intra business EC and Corporate portals Other E-C models and applications, innovative EC System-From E- government and learning to C2C, mobile commerce and pervasive computing	06



	EC Strategy and Implementation-EC strategy and global EC, Economics and Justification of EC, Using Affiliate marketing to promote your e- commerce business, Launching a successful online business and EC project, Legal, Ethics and Societal impacts of EC	
3	Digital Business Support services: ERP as e –business backbone, knowledge Tope Apps, Information and referral system Application Development: Building Digital business Applications and Infrastructure	06
4	Managing E-Business- Managing Knowledge, Management skills for e- business, Managing Risks in e –business Security Threats to e-business -Security Overview, Electronic Commerce Threats, Encryption, Cryptography, Public Key and Private Key Cryptography, Digital Signatures, Digital Certificates, Security Protocols over Public Networks: HTTP, SSL, Firewall as Security Control, Public Key Infrastructure (PKI) for Security, Prominent Cryptographic Applications	06
5	E-Business Strategy- E-business Strategic formulation- Analysis of Company's Internal and external environment, Selection of strategy, E-business strategy into Action, challenges and E-Transition (Process of Digital Transformation)	04
6	Materializing e-business: From Idea to Realization- Business plan preparation Case Studies and presentations	08

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1. A textbook on E-commerce, Er Arunrajan Mishra, Dr W K Sarwade, Neha Publishers & Distributors, 2011
2. E-commerce from vision to fulfilment, Elias M. Awad, PHI-Restricted, 2002
3. Digital Business and E-Commerce Management, 6th Ed, Dave Chaffey, Pearson, August 2014



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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, VinocenzoMorabito, 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
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10. Measuring Digital Economy-A new perspective - DOI:[10.1787/9789264221796-en](https://doi.org/10.1787/9789264221796-en)OECD Publishing



Course Code	Course Name	Credits
OE8409	Environmental Management	03

Objectives:

1. Understand and identify environmental issues relevant to India and global concerns
2. Learn concepts of ecology
3. Familiarise environment related legislations

Outcomes: Learner will be able to...

1. Understand the concept of environmental management
2. Understand ecosystem and interdependence, food chain etc.
3. Understand and interpret environment related legislations

Module	Detailed Contents	Hrs
01	Introduction and Definition of Environment: Significance of Environment Management for contemporary managers, Career opportunities. Environmental issues relevant to India, Sustainable Development, The Energy scenario.	10
02	Global Environmental concerns : Global Warming, Acid Rain, Ozone Depletion, Hazardous Wastes, Endangered life-species, Loss of Biodiversity, Industrial/Man- made disasters, Atomic/Biomedical hazards, etc.	06
03	Concepts of Ecology: Ecosystems and interdependence between living organisms, habitats, limiting factors, carrying capacity, food chain, etc.	05
04	Scope of Environment Management, Role & functions of Government as a planning and regulating agency. Environment Quality Management and Corporate Environmental Responsibility	10
05	Total Quality Environmental Management, ISO-14000, EMS certification.	05
06	General overview of major legislations like Environment Protection Act, Air (P & CP) Act, Water (P & CP) Act, Wildlife Protection Act, Forest Act, Factories Act, etc.	03



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2. A Handbook of Environmental Management Edited by Jon C. Lovett and David G.Ockwell, Edward Elgar Publishing
3. Environmental Management, **T V Ramachandra and Vijay Kulkarni, TERI Press**
4. Indian Standard Environmental Management Systems — Requirements With Guidance For Use, Bureau Of Indian Standards, February 2005
5. Environmental Management: An Indian Perspective, S N Chary and Vinod Vyasulu, Macmillan India, 2000
6. Introduction to Environmental Management, Mary K Theodore and Louise Theodore, CRC Press
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