VIVEKANAND EDUCATION SOCIETY

INSTITUTE OF TECHNOLOGY (AUTONOMOUS)

Hashu Advani Memorial Complex, Collector's Colony,
Chembur, Mumbai, 400074, Maharashtra, India
www.vesit.ac.in

VESIT

V.E.S.

Since 1962

Syllabus Approved By:

Academic Council of V.E.S. Institute of Technology

for the Academic Year: 2026-27

Preamble

Engineering education forms the cornerstone of technological innovation, industrial advancement, and societal transformation. As the world navigates an era of rapid change driven by automation, artificial intelligence, sustainable technologies, and global connectivity, VESIT positions itself as a catalyst for cultivating a dynamic learning ecosystem.

At VESIT, we strive to foster critical thinking, technical expertise, academic excellence, and holistic development among aspiring engineers. We are committed to shaping professionals who are adaptable, collaborative and are also deeply conscious of their social and environmental responsibilities.

Leveraging its autonomous status and affiliation with the University of Mumbai, VESIT designs a forward-thinking, outcome-based curriculum that emphasizes industry relevance and experiential learning.

The syllabus at VESIT has been structured in alignment with the principles of the National Education Policy (NEP) 2020, focusing on flexibility and multidisciplinary learning. The key thrust areas of education at VESIT include:-

Student-Centric Approach:

The programme is designed to offer students greater autonomy in shaping their academic journey. The syllabus comprises of **Core (Major) and Minor courses** from Diverse Disciplines as well as a wide range of **Open Electives**. Students can tailor their learning paths based on their interests and career aspirations. The curriculum also integrates mentored field projects and on the job training, providing valuable hands-on experience. Additionally, students with a research inclination can also explore **research-based projects** or pursue **Honours by Research.**

Multidisciplinary Approach:

VESIT's curriculum reflects a strong interdisciplinary focus, incorporating emerging fields and cutting-edge technologies. Courses are designed to bridge various domains with offerings such as **Machine learning, Artificial Intelligence & Data Science, Cyber Security, Geographic Information Systems (GIS), Internet of Things (IoT), Register transfer level VLSI, Robotics, Quantum Technologies, Mobile application**

development, Industrial Automation, Edge Computing and Embedded Intelligence and Information Security.

This approach encourages broader thinking and prepares students for diverse career paths.

Emphasis on Conceptual Clarity:

The curriculum lays stress also on a strong theoretical foundation, ensuring that students gain deep conceptual understanding, which is essential for mastering advanced topics and solving real-world problems.

Fostering Creativity and Critical Thinking:

Courses are designed to nurture a critical and creative mindset, promoting analytical reasoning, problem-solving, and innovation. Students are encouraged to question, explore, and think beyond conventional solutions.

Comprehensive Evaluation and Assessment:

Student performance is assessed through a number of assessment tools that includes the Mid-term Tests, Continuous Assessments, End-Semester Examinations. These evaluation tools are designed to measure the knowledge retention of students as well as their ability to apply concepts effectively in practical situations.

Guided by a vision of excellence and inclusivity, and supported by a passionate faculty, VESIT aspires to be a hub where ideas flourish, startups emerge, and industry-academia partnerships thrive. Our goal is to transform students into innovators, entrepreneurs, researchers and responsible leaders poised to drive sustainable growth and meaningful change in society.

Dr. (Mrs.) J. M. Nair	Dr. (Mrs.) M. Vijayalakshmi	Dr. (Mrs.) Gresha S. Bhatia
Principal, VESIT	Vice Principal, VESIT	Academic Coordinator, VESIT

Preamble of Department of Electronics and Computer Science

The Electronics and Computer Science (ECS) department at VESIT is revolutionizing engineering education, by integrating interdisciplinary studies and adhering to NEP 2020 guidelines. Encompassing cutting-edge domains such as Artificial Intelligence, Deep Learning, and Edge Computing, alongside foundational pillars like VLSI, Embedded Systems, IoT, Cloud Computing, Cybersecurity, and Industry 4.0, the curriculum drives modern technological advancement.

The ECS curriculum is designed to blend theoretical foundations with practical, hands-on experience. It emphasizes real-world applications, problem-solving, and innovation through project-based learning, internships, research opportunities, and industry collaborations. The undergraduate program, structured across 170 credits, includes Program Core Courses (PCC), Program Elective Courses (PEC), Mandatory Minor (MDM-1), Open Electives (OE), Vocational and Skill Enhancement Courses (VSE), Value Education Courses (VE) and many more categories offers basic degree in **"Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor".**

The program also offers optional degree courses like **"Bachelor of Technology (Honours with Research) in Electronics and Computer Science with Multidisciplinary Minor"** and "**Bachelor of Technology in Electronics and Computer Science with Double Minors"**

The NEP guidelines allows to design a curriculum with a strong foundation in Electronics and Computer Science through program core courses. It further produces globally competent through multidisciplinary and program elective courses. The program curriculum generates socially responsible graduates through value education courses. The graduates are ethically grounded and capable of independently solving complex problems through multidisciplinary, innovative, and sustainable approaches through courses in honours with research, Indian Knowledge System, field projects, and capstone projects.

Along the guidelines of **NEP 2020,** the department empowers students to become **entrepreneurs, innovative problem-solvers, transformative leaders**, and **responsible global citizens**, equipped to lead and thrive in a technology-driven era.

Dr. (Mrs.) Naveeta Kant
HoD, ECS Department,VESIT

Dr. (Mrs.) Rajani Mangala
Deputy HoD, ECS Department,VESIT

Electronics and Computer Science (ECS) Department

UG Degree Program Details

AY 2026-27

VIVEKANAND EDUCATION SOCIETY'S
Institute of Technology
(An Autonomous Institute Affiliated to University of Mumbai, Approved by A.I.C.T.E & Recognized by Govt. of Maharashtra)
Department of Electronics and Computer Science

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Degree Programs offered by the Institute according to NEP guidelines

Sr. No.	Degree Program
1	Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor in *domain name*^
2	Bachelor of Technology (Honours with Research) in Electronics and Computer Science with Multidisciplinary Minor *domain name*^
3	Bachelor of Technology in Electronics and Computer Science with Double Minors in *domain name*^ and *Minor in Emerging Areas**

Degree Programs and their corresponding requirements of courses

Sr. No.	Degree Program	MDM Courses	MEA Courses	Honours with Research
1	Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor in *domain name*^	Yes	NA	NA
2	Bachelor of Technology (Honours with Research) in Electronics and Computer Science with Multidisciplinary Minor *domain name*^	Yes	NA	Yes
3	Bachelor of Technology in Electronics and Computer Science with Double Minors in *domain name*^ and *Minor in Emerging Areas**	Yes	Yes	NA

Semester wise credit allocation for various Degree Programs

Sr. No.	Degree Program / Semester	I	II	III	IV	V	VI	VII	VIII	Total
1	Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor in *domain name*^	21	21	20	24	22	22	22	18	170
2	Bachelor of Technology (Honours with Research) in Electronics and Computer Science with Multidisciplinary Minor *domain name*^	21	21	20	24	22 +4$	22 +5$	22+ 4$	18+ 5$	188
3	Bachelor of Technology in Electronics and Computer Science with Double Minors in *domain name*^ and *Minor in Emerging Areas**	21	21	20	24	22 +4$	22 +5$	22+ 5$	18+ 4$	188

^ Domain given by ECS department to all the students with compulsory courses
** The name will depend on the domain selected by the student as applicable*
$ Extra credits to be earned from fifth semester onwards for the mentioned program degrees

Methodology of abbreviation for the various courses

Course code syntax

Year	Department	Course abbreviation	Semester	Serial Number
(implantation year of the **syllabus** applicable to FE – BE students	ECS = EC	(as given below)	(1 to 8)	(starts from 1 in each semester for a particular course type)

Note – (i) For all lab courses 'L' proceeds the semester number
(ii) In case of multiple electives in a given semester the course abbreviation ends with the elective course's serial number (PE1 to PE5)

Abbreviations used in the course codes

AE	Ability Enhancement Courses
BS	Basic Science Courses
CC	Co-curricular Courses
CP	Capstone Project
EM	Entrepreneurship, Economics and Management Courses
ES	Engineering Science Courses
FP	Field Project
HR	Honours with Research
IK	Indian Knowledge System
MEA	Minor in Emerging Areas Courses
MM	Multidisciplinary Minor Courses (MDM)
OE	Open Elective Courses
OJT	On Job Training
PC	Program Core Courses
PE	Program Elective Courses
RM	Research Methodologies
VE	Value Education Courses
VSE	Vocational and Skill Enhancement Courses

Table showing details of number of courses in each course type and credits assigned to them semester wise

Sr. No.	Abbr.	Course Type	I	II	III	IV	V	VI	VII	VIII	Total
1	AE	Ability Enhancement Courses	-	1:2	1:2	-	-	-	-	-	2:4
2	BS	Basic Science Courses	1:4	2:9	-	-	-	-	-	-	3:13
3	CC	Co-curricular Courses	1:2	1:2	-	-	-	-	-	-	2:4
4	CP	Capstone Project	-	-	-	-	-	1:2	1:2	-	2:4
5	EM	Entrepreneurship, Economics and Management Courses	-	-	1:2	1:2	-	-	-	-	2:4
6	ES	Engineering Science Courses	2:7	1:4	-	-	-	-	-	-	3:11
7	FP	Field Project	-	-	-	1:2	-	-	-	-	1:2
8	HR	Honours with Research	-	-	-	-	1:4	1:5	1:4	1:5	4:18#
9	IK	Indian Knowledge System	1:2	-	-	-	-	-	-	-	1:2
10	MEA	Minor in Emerging Areas Courses	-	-	-	-	1:4	1:5	1:5	1:4	4:18@
11	MM	Multidisciplinary Minor Courses	-	-	1:4	1:4	1:4	1:2	-	-	4:14
12	OE	Open Elective Courses	-	-	-	1:4	1:4	-	-	-	2:8
13	OJT	On Job Training	-	-	-	-	-	-	-	1:12	1:12
14	PC	Program Core Courses	1:2	-	3:12	3:10	3:10	2:8	2:8	2:6	16:56
15	PE	Program Elective Courses	-	-	-	-	1:4	2:8	2:8	-	5:20
16	RM	Research Methodologies	-	-	-	-	-	-	1:4	-	1:4
17	VE	Value Education Courses	1:2	1:2	-	-	-	-	-	-	2:4
18	VSE	Vocational and Skill Enhancement Courses	1:2	1:2	-	1:2	-	1:2	-	-	4:8
		B.Tech. in ECS with MDM in *domain name*^	8:21	7:21	6:20	8:24	6:22	7:22	6:22	3:18	51:170
		Total for the B.Tech. (Honours with Research) in ECS with MDM in *domain name*^ / B.Tech. in ECS with Double Minors in *domain name*^ and *MEA**	8:21	7:21	6:20	8:24	7:26	8:28	7:27	4:23	55:188

^ *Domain given by ECS department to all the students with compulsory courses*
* *The name will depend on the domain selected by the student as applicable,*
@ *To be counted for the degree B.Tech. in ECS with Double Minors in IoT and MEA**
# *To be counted for the degree B.Tech. (Honours with Research) in ECS with MDM in IoT*

Table showing marks allocated to various types of courses semester wise

Sr. No.	Abbr.	Course Type	I	II	III	IV	V	VI	VII	VIII	Total
1	AE	Ability Enhancement Courses	-	100	50	-	-	-	-	-	150
2	BS	Basic Science Courses	100	225	-	-	-	-	-	-	325
3	CC	Co-curricular Courses	25	25	-	-	-	-	-	-	50
4	CP	Capstone Project	-	-	-	-	-	100	150	-	250
5	EM	Entrepreneurship, Economics and Management Courses	-	-	50	25	-	-	-	-	75
6	ES	Engineering Science Courses	225	125	-	-	-	-	-	-	350
7	FP	Field Project	-	-	-	50	-	-	-	-	50
8	HR	Honours with Research	-	-	-	-	100	150	100	150	500
9	IK	Indian Knowledge System	20	-	-	-	-	-	-	-	20
10	MEA	Minor in Emerging Areas Courses	-	-	-	-	150	150	150	100	550
11	MM	Multidisciplinary Minor Courses	-	-	150	150	150	100	-	-	550
12	OE	Open Elective Courses	-	-	-	100	100	-	-	-	200
13	OJT	On Job Training	-	-	-	-	-	-	-	100	100
14	PC	Program Core Courses	100	-	450	450	425	300	300	200	2225
15	PE	Program Elective Courses	-	-	-	-	150	300	300	-	750
16	RM	Research Methodologies	-	-	-	-	-	-	100	-	100
17	VE	Value Education Courses	20	20	-	-	-	-	-	-	40
18	VSE	Vocational and Skill Enhancement Courses	50	50	-	50	-	50	-	-	200
		B.Tech. in ECS with MDM in *domain name*^	540	545	700	825	825	850	850	300	5285
		B.Tech. (Honours with Research) in ECS with MDM in *domain name*^	540	545	700	825	925	1000	950	450	5785
		B.Tech. in ECS with Double Minors in *domain name*^ and *MEA**	540	545	700	825	975	1000	1000	400	5835

Credit to hours conversion for various activities

1. Theory: 1 credit = 13 to 15 hrs of teaching.
2. Lab: 1 Credit = 26 to 30 hrs of lab work.
3. Field Project: 1 Credit = 26 to 30 hrs of learning activities which includes 13 to 15 hrs of activities preparation, report writing, independent reading etc.
4. Studio Activities: 1 Credit= 26 to 30 hrs of creative activities for the Capstone projects etc.
5. Workshop Based Activities: 1 Credit = 26 to 30 hrs of hands-on activities related to Vocational/professional practice/skill based.
6. Seminar/Group Discussion: 1 Credit = 13 to 15 hrs of participation.
7. Internship: 1 credit = 2 weeks of industry engagement.

Courses offered for various Degrees

Semester	MDM	MEA	Honours with Research
III	Microprocessor and Microcontroller	--	--
IV	Embedded System and RTOS	--	--
V	Internet of Things	Applied AI for Engineering Systems	As per guidelines provided
VI	IIoT & Industry 4.0	Intelligent Systems & Real-world AI Applications	As per guidelines provided
VII	--	Edge AI & Embedded Intelligence	As per guidelines provided
VIII	--	NPTEL Course or Online MOOC	As per guidelines provided

1	Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor in *domain name*^

Courses offered in Multidisciplinary Minors (MDM-1)

(Applicable to all the Degree programs)

Domain – Internet of Things (IoT)

Course Code	Semester	Course Name	Credits
26ECMM31	III	Microprocessor and Microcontroller	4
26ECMM41	IV	Embedded System and RTOS	4
26ECMM51	V	Internet of Things	4
26ECMM61	VI	IIoT & Industry 4.0	2

2	Bachelor of Technology (Honours with Research) in Electronics and Computer Science with Multidisciplinary Minor *domain name*^

Honours with Research

Selection Criteria, Procedure and Evaluation Guidelines

The B.Tech. Degree with Multidisciplinary Minor and honours with research will be awarded as per the following guidelines.

Rules and Regulations

The **"Honours with Research"** is a **4-year undergraduate degree** that includes a **major research project or dissertation** in the third and fourth year. It allows academically strong students to dive deeper into their subject of interest, preparing them for research careers or direct entry into doctoral programs.

Objectives of the "Honours with Research" Track

- Promote early research orientation in undergraduate education.
- Foster independent thinking and analytical skills.
- Build a pipeline of researchers and innovators.
- Make graduates internationally competitive.

Key Features

To obtain a **B.E/B.Tech. (Honours with Research)** degree:

Feature	**Details**
Duration	2 year full time (four semesters.)
Academic Requirement CGPA Requirement	1. Must have passed all courses from semesters 1 to 4. 2. Minimum 7.0 CGPA by end of second year(IVth sem) 3. Minimum 7.0 CGPA has to be maintained for 5th and 6th semester also.
Research Requirement	A full research project/thesis in the 3rd and 4th year earning an additional 18 credits supervised by an academia.
Important note	1. Honours with research project has to be different from the regular project 2. This project would span a total for 4 semesters.

Key Guidelines

- Research should be conducted in collaboration with an institute of eminence or with a research organization or internal research work with very high intrinsic value.
- Must be conducted under supervision of VESIT internal faculty
- Encouraged to align with ongoing institutional research or societal/industrial needs.
- Research should reflect originality, problem-solving, and application of domain knowledge. The research should adhere to plagiarism and ethics standards

Semester	Course Code	Termwork Marks	Presentation and oral Marks	Total Credits
V	26ECHR5	50	50	4
VI	26ECHR6	50	100	5
VII	26ECHR7	50	50	4
VIII	26ECHR8	50	100	5

b. Timeline (Initiated in 5th semester- 8th Semester)

- Semester 5: 4 credits
    - Finalize topic & research guide
    - Submit proposal & begin initial work
    - Literature review
    - Termwork: 50 marks - Presentation and oral: 50 marks

- Semester 6: 5 credits
    - Methodology Design
    - Initiation of implementation
    - Midterm review
    - Submit progress report
    - Termwork: 50 marks, Presentation and oral: 100 marks

- Semester 7: 4 credits
    - Complete experimental/simulation work
    - Submit progress report
    - Termwork: 50 marks, Presentation and oral: 50 marks

- Semester 8: 5 credits
  - Research Publications/Patent/Product
  - Final report submission
  - Oral defense (viva)
  - Termwork: 50 marks, Presentation and oral: 100 marks

Methodology Design	Clarity in experimental setup or analytical framework
Implementation Work	Coding, simulation, modeling, or lab work
Innovation/Originality	Novelty of approach or findings, critical thinking
Progress Reports	Monthly or bi-monthly updates, mentor feedback
Documentation Quality	Interim reports, thesis structure, formatting
Presentation & Viva	Mid-term and final evaluation by a panel
Logbook/Research Diary	Record of weekly progress, meetings, and reflections
Ethics & Plagiarism	Ethical standards, plagiarism check compliance (e.g..<10%)

Suggested Assessment Tools:

Criteria	Excellent	Good	Satisfactory	Needs Improvement
Research	Clear, original, well-structured	Relevant and clear	Adequate, lacks depth	Vague, lacks direction
Literature Review	Comprehensive, current	Good coverage	Limited sources	Incomplete or irrelevant
Methodology	Well-designed and justified	Good design	Basic approach	Inadequate or unclear
Implementation	Thorough and accurate	Complete	Partially complete	Incomplete or flawed
Progress & Commitment	Regular updates, highly engaged	Good progress	Irregular effort	Lack consistency
Report quality	Clear, well-structured, properly cited	Well written	Some structure issues	Poorly organized
Presentation and viva	Confident, clear, responsive	Clear and adequate	Lacks clarity	Unclear or unprepared
Research Diary / Logbook	Detailed and consistent	Complete	Some missing entries	Not maintained

The work will be evaluated in each semester on the following points.

Assessment Tools	Sem V	Sem VI	Sem VII	Sem VIII
Literature Survey	15	-	-	-
Work done during the semester	15	30	30	30
Results & Analysis	10	30	30	30
Presentation skills	10	20	20	20
Outcome of honours with research (participation in competition/Prototype/Paper presentation in conference/ paper publication in journal/Patent etc.)	-	20	20	20
Term work	50	50	50	50
Total Marks	100	150	100	150

3	Bachelor of Technology in Electronics and Computer Science with Double Minors in *domain name*^ and *Minor in Emerging Areas**

Technology domains under Minor in Emerging Areas (MEA)

The MEA program features courses in emerging areas of technology domains offered by various departments to the eligible students, including ECS students. Summary tables of these domains are presented below, in Tables 1 through 7.

Table 1. Domains in the emerging areas offered by various departments

Departments	Technology domains
Electronics and Computer Science	Edge Computing and Embedded Intelligence
Computer Engineering	Quantum Technologies
Information Technology	Robotics
Artificial Intelligence and Data Science	Internet of Things
Automation and Robotics	Information Security
Electronics and Telecommunication	RTL VLSI Designs

Table 2. Courses offered by Electronics and Computer Science department

Technology domain – Edge Computing and Embedded Intelligence				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26ECMEA51	Applied AI for Engineering Systems	V	4
2	26ECMEA61	Intelligent Systems & Real-world AI Applications	VI	5
3	26ECMEA71	Edge AI & Embedded Intelligence	VII	5
4	26ECMEA81	NPTEL Course or online MOOC	VIII	4

Table 3. Courses offered by Computer Engineering department

Technology domain – Quantum Technologies				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26CMMEA51	Foundations of Quantum	V	4
2	26CMMEA61	Quantum Circuits and Algorithms	VI	5
3	26CMMEA71	Quantum Computation/Quantum Communication	VII	5
4	26CMMEA81	NPTEL Course or online MOOC	VIII	4

Table 4. Courses offered by Information Technology department

Technology domain – Robotics				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26ITMEA51	Fundamentals Of Robotics	V	4
2	26ITMEA61	Industrial Automation and Robotics	VI	5
3	26ITMEA71	Machine Vision and AI for Robotics	VII	5
4	26ITMEA81	NPTEL Course or online MOOC	VIII	4

Table 5. Courses offered by Artificial Intelligence and Data Science department

Technology domain – Internet Of Things				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26ADMEA51	IOT Sensor System	V	4
2	26ADMEA61	IOT Architecture & Protocols	VI	5
3	26ADMEA71	Data Paradigms in IOT	VII	5
4	26ADMEA81	NPTEL Course or online MOOC	VIII	4

Table 6. Courses offered by Automation and Robotics department

Technology domain – Information Security				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26ARMEA51	Digital Forensics and IoT security	V	4
2	26ARMEA61	Industrial Control System Cyber Security	VI	5
3	26ARMEA71	Cloud Security Architecture	VII	5
4	26ARMEA81	Online course (related to Information Security)	VIII	4

Table 7. Courses offered by Electronics and Telecommunication Engineering

Technology domain – RTL VLSI Designs				
Sr. No.	Course Code	Course Name	Semester	Credits
1	26ETMEA51	Advance Digital System Design	V	4
2	26ETMEA61	Design with Verilog	VI	5
3	26ETMEA71	Verification with System Verilog	VII	5
4	26ETMEA81	NPTEL Course or online MOOC	VIII	4

Program Elective Courses

(Applicable to all the Degree programs)

Program Elective Courses (PEC-1) offered in semester - V

Course Code	Semester	Course Name	Credits
26ECPE151	V	Statistics for Engineers	4
26ECPE152	V	Design and Analysis of Algorithms	4
26ECPE153	V	Communication System	4

Program Elective Courses (PEC-2) offered in semester - VI

Course Code	Semester	Course Name	Credits
26ECPE261	VI	Software Testing and Quality Assurance	4
26ECPE262	VI	Machine Learning	4
26ECPE263	VI	Data Warehouse and Mining	4

Program Elective Courses (PEC-3) offered in semester - VI

Course Code	Semester	Course Name	Credits
26ECPE361	VI	Digital Image Processing	4
26ECPE362	VI	Micro Electro-Mechanical Systems	4
26ECPE363	VI	Principles of Control System	4

Program Elective Courses (PEC-4) offered in semester - VII

Course Code	Semester	Course Name	Credits
26ECPE471	VII	Robotics	4
26ECPE472	VII	Electric Vehicles	4
26ECPE473	VII	Wireless Technology	4

Program Elective Courses (PEC-5) offered in semester - VII

Course Code	Semester	Course Name	Credits
26ECPE571	VII	Cloud Computing and GPU	4
26ECPE572	VII	Cyber Security	4
26ECPE573	VII	Blockchain Technology	4

Open Elective Courses

(Applicable to all the Degrees)

Open Elective Courses offered in semester – IV

List of Courses: (will be announced as per the schedule of NPTEL, which is announced before the commencement of the respective semesters)

Course Code	Semester	Course Name	Credits
26ECOE14X	IV	*To be announced*	4

Open Elective Courses offered in semester - V

Course Code	Semester	Course Name	Credits
26ECOE251	V	German - II	4
26ECOE252	V	Soft Skills	4
26ECOE253	V	Public Speaking	4
26ECOE254	V	Business to Business Marketing (B2B)	4
26ECOE255	V	Privacy and Security in Online Social Media	4
26ECOE256	V	German - I	4
26ECOE257	V	E-Business	4

Schema and marking scheme: Semester - I

Teaching mode & credit allocation for semester -I

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
BS	26ECBS11	Fundamentals of Engineering Mathematics-1	03	--	01	03	--	01	04
ES	26ECES12	Fundamentals of Programming	03	02	–	03	01	--	04
	26ECES14	Engineering Mechanics	03	--	–	03	–	--	03
PC	26ECPC13	Programme Core Course	02	–	–	02	–	–	02
IK	26ECIK11	Fundamentals of Vedic Mathematics	02	--	–	02	--	--	02
VE	26ECVE11	Universal Human Values-1	02	--	--	02	--	--	02
VSE	26ECVSE12	Basic Workshop Practice	–	04	–	–	02	–	02
CC	26ECCC11	Co-curricular Course	--	04	--	–	02	--	02
								Total Credit	21

Marking Scheme for semester -I

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
BS	26ECBS11	Fundamentals of Engineering Mathematics-1	60	20	20	--	--	100
ES	26ECES12	Fundamentals of Programming	60	20	20	25	--	125
	26ECES14	Engineering Mechanics	60	20	20	--	--	100
PC	26ECPC13	Programme Core Course	60	20	20	--	--	100
IK	26ECIK11	Fundamentals of Vedic Mathematics	--	--	20	--	--	20
VE	26ECVE11	Universal Human Values-1	--	--	20	--	--	20
VSE	26ECVSE12	Basic Workshop Practice	--	--	--	50	--	50
CC	26ECCC11	Co-curricular Course	--	--	--	--	25	25
		Total	240	80	120	75	25	540

Schema and marking scheme: Semester - II

Teaching mode & credit allocation for semester -II

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
BS	26ECBS21	Fundamentals of Engineering Mathematics-2	03	--	01	03	--	01	04
	26ECBS22	Engineering Science	04	02	--	04	01	--	05
ES	26ECES21	Basic Electrical Engineering	03	02	–	03	01	--	04
AE	26ECAE21	Professional Communications and Ethics-I	01	02	--	01	01	--	02
VSE	26ECVS21	Engineering visualization lab	–	02	–	–	02	--	02
VE	26ECVE21	Universal Human Values-2	02	--	--	02	--	--	02
CC	26ECCC21	Co-curricular Course	--	04	--	–	02	--	02
								Total Credit	21

Marking Scheme for semester -II

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
BS	26ECBS21	Fundamentals of Engineering Mathematics-2	60	20	20	--	--	100
	26ECBS22	Engineering Science	60	20	20	25	--	125
ES	26ECES21	Basic Electrical Engineering	60	20	20	25	--	125
AE	26ECAE21	Professional Communications and Ethics-I	--	20	80	--	--	100
VSE	26ECVS21	Engineering visualization lab	--	--	--	25	25	50
VE	26ECVE21	Universal Human Values-2	--	--	20	--	--	20
CC	26ECCC21	Co-curricular Course	--	--	--	--	25	25
		Total	180	80	160	75	50	545

Schema and marking scheme: Semester - III

Teaching mode & credit allocation for semester -III

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
PCC	26ECPC31/ 26ECPCL31	Data Structures	3	2	---	3	1	---	4
PCC	26ECPC32/ 26ECPCL32	Digital System Design	3	2	---	3	1	---	4
PCC	26ECPC33/ 26ECPCL33	Database Management System	3	2	---	3	1	---	4
MDM	26ECMM31/ 26ECMML31	Microprocessor and Microcontroller	3	2	---	3	1	---	4
EM	26ECEM31	Finance Management for Engineers	2	---	---	2	---	---	2
AEC	26ECAE31/ 26ECAEL31	Professional Communication and Ethics II	1	2	---	1	1	---	2
								Total Credit	20

Marking Scheme for semester -III

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
PCC	26ECPC31/ 26ECPCL31	Data Structures	60	20	20	25	25	150
PCC	26ECPC32/ 26ECPCL32	Digital System Design	60	20	20	25	25	150
PCC	26ECPC33/ 26ECPCL33	Database Management System	60	20	20	25	25	150
MDM	26ECMM31/ 26ECMML31	Microprocessor and Microcontroller	60	20	20	25	25	150
EM	26ECEM31	Finance Management for Engineers	30	20	---	---	---	50
AEC	26ECAE31/ 26ECAEL31	Professional Communication and Ethics II	---	---	---	50	---	50
		Total	270	100	80	150	100	700

Schema and marking scheme: Semester - IV

Teaching mode & credit allocation for semester - IV

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
PCC	26ECPC41/ 26ECPCL41	Electronic Devices and Circuits	3	2	---	3	1	---	4
PCC	26ECPC42/ 26ECPCL42	Operating Systems	2	2	---	2	1	---	3
PCC	26ECPC43/ 26ECPCL43	Signal & Systems	2	2	---	2	1	---	3
MDM	26ECMM41/ 26ECMML41	Embedded System and RTOS	3	2	---	3	1	---	4
OE	26ECOE14X	Open Elective (NPTEL MOOC Course)	##	---	---	##	---	---	4
EM	26ECEM41	Introduction to Innovation and Entrepreneurship for Engineers	---	---	2	---	---	2	2
VSEC	26ECVSEL41	Full Stack Development	---	4	---	---	2	---	2
FP	26ECFP41	Field Project	---	4	---	---	2	---	2
								Total Credit	24

Marking Scheme for semester - IV

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
PCC	26ECPC41/ 26ECPCL41	Electronic Devices and Circuits	60	20	20	25	25	150
PCC	26ECPC42/ 26ECPCL42	Operating Systems	60	20	20	25	25	150
PCC	26ECPC43/ 26ECPCL43	Signal & Systems	60	20	20	25	25	150
MDM	26ECMM41/ 26ECMML41	Embedded System and RTOS	60	20	20	25	25	150
OE	26ECOE14X	Open Elective (NPTEL MOOC Course)	##					100
EM	26ECEM41	Introduction to Innovation and Entrepreneurship for Engineers	---	---	---	25	---	25
VSEC	26ECVSEL41	Full Stack Development	---	---	---	25	25	50
FP	26ECFP41	Field Project	---	---	---	25	25	50
		Total						825

- Students are required to complete a 12 weeks MOOC course from the suggested list recommended by the department.

Schema and marking scheme: Semester - V

Teaching mode & credit allocation for semester - V

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
PCC	26ECPC51/ 26ECPCL51	Digital VLSI	3	2	---	3	1	---	4
PCC	26ECPC52	Digital Signal Processing	3	---	1*	3	---	---	3
PCC	26ECPC53/ 26ECPCL53	Software Engineering	2	2	---	2	1	---	3
PEC	26ECPE15X/ 26ECPE1L5X	Program Elective 1	3	2	---	3	1	---	4
MDM	26ECMM51/ 26ECMML51	Internet of Things	3	2	---	3	1	---	4
OE	26ECOE5X	Open Elective (NPTEL MOOC Course)	##	---	---	---	---	---	4
							Total Credit		22

- Non credit

Marking Scheme for semester - V

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
PCC	26ECPC51/ 26ECPCL51	Digital VLSI	60	20	20	25	25	150
PCC	26ECPC52	Digital Signal Processing	60	20	20	25	---	125
PCC	26ECPC53/ 26ECPCL53	Software Engineering	60	20	20	25	25	150
PEC	26ECPE15X/ 26ECPE1L5X	Program Elective 1	60	20	20	25	25	150
MDM	26ECMM51/ 26ECMML51	Internet of Things	60	20	20	25	25	150
OE	26ECOE5X	Open Elective (NPTEL MOOC Course)##	100	---	---	---	---	100
		Total	400	100	100	125	100	825

Program Electives (PEC 1)	Open Electives (OE)
26ECPE151: Statistics for Engineers	**26ECOE251:** German - II
26ECPE152: Design and Analysis of Algorithms	**26ECOE252:** Soft Skills
26ECPE153: Communication System	**26ECOE253:** Public Speaking
	26ECOE254: Business to Business Marketing (B2B)
	26ECOE255: Privacy and Security in Online Social Media
	26ECOE256: German - I
	26ECOE257: E-Business

Schema and marking scheme: Semester - VI

Teaching mode & credit allocation for semester - VI

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
PCC	26ECPC61/ 26ECPCL61	Analog VLSI	3	2	---	3	1	---	4
PCC	26ECPC62/ 26ECPCL62	Computer Communication and Networking	3	2	---	3	1	---	4
PEC	26ECPE26X/ 26ECPE2L6X	Program Elective 2	3	2	---	3	1	---	4
PEC	26ECPE36X/ 26ECPE3L6X	Program Elective 3	3	2	---	3	1	---	4
MDM	26ECMM61	IIoT & Industry 4.0	2	---	---	2	---	---	2
VSE	26ECVSEL61	ASIC Design Lab	---	2	1	---	1	1	2
CP	26ECCP161	Capstone Project-I	---	4	---	---	2	---	2
								Total credits	22

Marking Scheme for semester - VI

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
PCC	26ECPC61/ 26ECPCL61	Analog VLSI	60	20	20	25	25	150
PCC	26ECPC62/ 26ECPCL62	Computer Communication and Networking	60	20	20	25	25	150
PEC	26ECPE26X/ 26ECPE2L6X	Program Elective 2	60	20	20	25	25	150
PEC	26ECPE36X/ 26ECPE3L6X	Program Elective 3	60	20	20	25	25	150
MDM	26ECMM61	IIoT & Industry 4.0	60	20	20	---	---	100
VSE	26ECVSEL61	ASIC Design Lab	---	---	---	25	25	50
CP	26ECCP161	Capstone Project-I	---	---	---	50	50	100
		Total marks	300	100	100	175	175	850

Program Electives (PEC)

PEC 2	PEC 3
26ECPE261: Software Testing and Quality Assurance	**26ECPE361**: Digital Image Processing
26ECPE262: Machine Learning	**26ECPE362**: Micro Electro-Mechanical Systems
26ECPE263: Data Warehouse and Mining	**26ECPE363**: Principles of Control System

Schema and marking scheme: Semester - VII

Teaching mode & credit allocation for semester - VII

Course Type	Course code	Course Name	Teaching Scheme (Contact hrs)			Credits Assigned			
			Th	Pr	Tut	Th	Pr	Tut	Total
PCC	26ECPC71/ 26ECPCL71	Power Electronics and Applications	3	2	---	3	1	---	4
PCC	26ECPC72/ 26ECPCL72	Deep learning and GenAI	3	2	---	3	1	---	4
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 4	3	2	---	3	1	---	4
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 5	3	2	---	3	1	---	4
RM	26ECRM71	Research Methodology	---	---	---	---	---	---	4¥
Project	26ECCP271	Capstone Project-II	---	4	---	---	2	---	2
								Total credits	22

¥ - Students are required to complete a 12 weeks MOOC course on research methodology.

Marking Scheme for semester - VII

Course Type	Course code	Course Name	Teaching Scheme					
			SE	MT	CA	TW	PR/OR	Total
PCC	26ECPC71/ 26ECPCL71	Power Electronics & Applications	60	20	20	25	25	150
PCC	26ECPC72/ 26ECPCL72	Deep learning & GenAI	60	20	20	25	25	150
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 4	60	20	20	25	25	150
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 5	60	20	20	25	25	150
RM	26ECRM71	Research Methodology	---	---	100	---	---	100¥
Project	26ECCP271	Capstone Project-II	---	---	---	50	100	150
		Total marks	240	80	180	150	200	850

Program Electives (PEC 4)	Program Electives (PEC 5)
26ECPE471: Robotics	**26ECPE571:** Cloud Computing and GPU
26ECPE472: Electric Vehicles	**26ECPE572:** Cyber Security
26ECPE473: Wireless Technology	**26ECPE573:** Blockchain Technology

Schema and marking scheme: Semester - VIII

Teaching mode & credit allocation for semester - VIII

Course Type	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
		TH	PR	TUT	TH	PR	TUT	TOTAL
26ECPC81	MOOC Course 1	3	-	-	3	-	-	3
26ECPC82	MOOC Course 2	3	-	-	3	-	-	3
26ECOJT81	Internship/OJT	-	-	-	-	-	-	12[€]
Total Credits								18

€ Students need to follow the - Proposed Draft_V1_VESIT INTERNSHIP POLICY HANDBOOK (2026–27)

Marking Scheme for semester - VIII

Course Type	Course Name	TH	MT	CA	TW	PR/OR	Total
26ECPC81	MOOC Course 1	-	-	-	-	-	100
26ECPC82	MOOC Course 2	-	-	-	-	-	100
26ECOJT81	Internship/OJT	-	-	-	-	-	100
						Total Marks	300

Instructions:

1. NPTEL course-1 will be in Electronics domain.
2. NPTEL course-2 will be in Computer domain.
3. List of the courses of their respective domains will be displayed only in the beginning of the semester. (tentatively in January)
4. Students have to choose one of the courses in both the mentioned domains and complete the necessary assignments and pass the exams conducted by NPTEL.
5. Marks awarded in the aforesaid exam shall be converted to corresponding credits.

Evaluation Guidelines applicable to various types of degree programs under B.Tech.

The students are evaluated under the following heads wherever applicable:

- Mid-Term (MT)
- Continuous Assessment (CA)
- End Semester Exam (ESE)
- Term Work (TW)
- Practical/Oral Exams (PR/OR)

Mid-Term / Internal Assessment:	
1	Mid Term Test is evaluated for 20 marks.
2	Mid Term test is to be conducted for 50% of the prescribed syllabus.
3	Duration of the midterm test is one hour.

Continuous Assessment:

Continuous Assessment is of **20 marks**. The assessment tools are decided by the subject teachers. They can be any 2 or maximum 4 of the following:

Sr. No	Assessment tools	Marks
1	Certificate course for 4 weeks or more: NPTEL/ Coursera/ Udemy/any MOOC	10 marks
2	Wins in the event/competition/hackathon	10 marks
3	Content beyond syllabus presentation	10 marks
4	Creating Proof of concept	10 marks
5	Mini Project / Extra Experiments/ Virtual Lab	10 marks
6	GATE Based Assignment test/Tutorials etc	10 marks
7	Participation in event/workshop/talk / competition followed by small report and certificate of participation relevant to the subject (in other institutes)	05 marks
8	Multiple Choice Questions (Quiz)	05 marks
9	Peer Review and Participation	05 marks

End Semester Theory Examination: (60 marks theory exam)	
1	Question paper will be of 100 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 20 marks each.
4	**Any three questions out of five** needs to be solved.

End Semester Theory Examination: (30 marks theory exam)	
1	Question paper will be of 50 marks.
2	Question paper will have a total of five questions.
3	All questions have equal weightage and carry 10 marks each.
4	**Any three questions out of five** needs to be solved.

Term-Work: (25 marks)

Punctuality, Regularity in submission, and successful conduction of practical, mock viva/mini project will be considered in the evaluation of 25 marks term work.

25-Mark Rubric Framework

Total Lab Term Work Marks (25 Marks)

Continuous Lab Performance (15 marks)	Journal/Report writing (05 marks)	Lab Quiz, Viva Voce (05 marks)

- **Continuous Lab Performance**: Punctuality, pre-lab preparation, circuit/model setup, and safety protocols. Execution & analysis will include accuracy of data collection, tool/software handling, and result calculation.
- **Journal/Report Writing**: Regular documentation, error analysis, and reflection.
- **Lab Quiz, Viva-Voce**: Conceptual clarity and higher-order critical thinking.

Practical examination

The 25-Marks Rubric Breakdown

To ensure objective grading, the 25 marks are split across conceptual design, execution, data extraction, and viva-voce:

Sr. No.	Component	Tasks Assessed	Marks Allotted
1	Write-up & Design	Aim, circuit/block diagram, algorithm, or mathematical formulae.	05 Marks
2	Conduction & Setup	Connections, hardware assembly, coding, tool handling, and troubleshooting.	10 Marks
3	Results & Inference	Output verification, tabulation, graph plotting, and logical conclusions.	05 Marks
4	Viva-Voce	Spot testing of core concepts, logical reasoning, and application awareness.	05 Marks
	Total	**Comprehensive Competence Assessment**	**25 Marks**

Streamlined Exam Day Procedure (2-Hour Slot)

Because the weightage is lower, the time allocation is optimized to fit a **1.5 to 2-hour window** per student batch:

- **00 – 15 Mins (Allotment)**: Random selection of experiments via a lottery or automated token wheel.
- **15 – 35 Mins (Write-up)**: Students quickly write down the circuit/block diagram, core formulas, or logic flowchart.
- **35 – 85 Mins (Execution)**: Hardware wiring, simulation testing, or code compilation. Examiners track independent troubleshooting skills during this phase.
- **85 – 120 Mins (Evaluation & Viva)**: Examiners check final outputs, sign sheets, and conduct a brief 3-minute viva per student.

Method for conducting theory lectures, laboratory sessions and their evaluation tools

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

Semester wise syllabus Index for the Bachelor of Technology in Electronics and Computer Science with Multidisciplinary Minor in Internet of Things (IoT) MDM-1

Semester VII (AY 2026-27)			
Course Code	**Course Name**	**Credits**	**Page no.**
-	Semester VII Scheme	-	Sem-VII 2/47
26ECPC71/ 26ECPCL71	Power Electronics & Applications	4	Sem-VII 3/47
26ECPC72/ 26ECPCL72	Deep learning & GenAI	4	Sem-VII 7/47
26ECPE47X/ 26ECPE4L7X	Program Elective 4	4	Sem-VII 13/47
26ECPE47X/ 26ECPE4L7X	Program Elective 5	4	Sem-VII 25/47
26ECRM71	Research Methodology	4	Sem-VII 40/47
26ECCP271	Capstone Project-II	2	Sem-VII 42/47
Semester VIII (AY 2026-27)			
26ECPC81	MOOC Course 1	3	Sem-VIII 2/36
26ECPC82	MOOC Course 2	3	Sem-VIII 2/36
26ECOJT81	Internship/OJT	12	Sem-VIII 3/36

Department of
Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-III
A.Y. 2026-27

Department of Electronics and Computer Science

Course Type	Semester III Teaching Scheme (AY 2026-27)								
	Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
			TH	PR	TUT	TH	PR	TUT	Total
PCC	26ECPC31/ 26ECPCL31	Data Structures	3	2	---	3	1	---	4
PCC	26ECPC32/ 26ECPCL32	Digital System Design	3	2	---	3	1	---	4
PCC	26ECPC33/ 26ECPCL33	Database Management System	3	2	---	3	1	---	4
MDM	26ECMM31/ 26ECMML31	Microprocessor and Microcontroller	3	2	---	3	1	---	4
EM	26ECEM31	Finance Management for Engineers	2	---	---	2	---	---	2
AEC	26ECAE31/ 26ECAEL31	Professional Communication and Ethics II	1	2	---	1	1	---	2
	Total Credits								20

Course Type	Semester III Examination Scheme							
	Course Code	Course Name	TH	MT	CA	TW	PR/ OR	Total
PCC	26ECPC31/ 26ECPCL31	Data Structures	60	20	20	25	25	150
PCC	26ECPC32/ 26ECPCL32	Digital System Design	60	20	20	25	25	150
PCC	26ECPC33/ 26ECPCL33	Database Management System	60	20	20	25	25	150
MDM	26ECMM31/ 26ECMML31	Microprocessor and Microcontroller	60	20	20	25	25	150
EM	26ECEM31	Finance Management for Engineers	30	20	---	---	---	50
AEC	26ECAE31/ 26ECAEL31	Professional Communication and Ethics II	---	---	---	50	---	50
	Total Marks							700

<table>
<tr><th colspan="9">Data Structures</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Course Name</th><th colspan="3">Teaching Scheme
(Hours per week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><th>TH</th><th>PR</th><th>Tut</th><th>TH</th><th>PR</th><th>Tut</th><th>Total</th></tr>
<tr><td>26ECPC31</td><td>Data Structures
(Theory)</td><td>03</td><td>---</td><td>---</td><td>03</td><td>---</td><td>---</td><td>03</td></tr>
<tr><td>26ECPCL31</td><td>Data Structures
(Lab)</td><td>---</td><td>02</td><td>---</td><td>---</td><td>01</td><td>---</td><td>01</td></tr>
<tr><td colspan="8" align="right">Total Credits</td><td>04</td></tr>
</table>

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite: Knowledge of one or more programming language e.g. C, C++. JAVA, Python and proficiency in any one of them.

Course Objectives:

1	Understand data structure classifications, operations, and static versus dynamic memory allocation.
2	Implement and apply arrays, strings, pointers, stacks, and queues to solve problems like expression conversion.
3	Master singly, doubly, and circular linked lists and use them to implement stacks and queues.
4	Analyze binary trees, binary search trees, traversals, and applications like Huffman encoding.
5	Explore graph representations (matrix and list), traversals (DFS, BFS), and topological sorting.
6	Evaluate searching, sorting techniques, complexity analysis, and hashing with collision resolution.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Explain foundational data structure types, memory allocation methods, and basic operations.
2	Design and manipulate arrays, pointers, strings, stacks, and queues for practical computational tasks.
3	Construct singly, doubly, and circular linked lists to build dynamic data structures like stacks and queues.
4	Analyze binary trees, binary search trees, and tree traversal algorithms to solve hierarchical problems.
5	Utilize graph representations, traversals (DFS and BFS), and topological sorting for network-based problems.
6	Analyze the time-space complexity of searching and sorting algorithms, and apply hashing with collision resolution strategies.

Module	Theory Course Contents	Hrs
1	**Introduction to Data Structures**	**05**
1.1	Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures, Concept of array, Static arrays vs Dynamic Arrays.	
1.2	Arrays, Pointers and Strings: Introduction to Arrays, Definition, One Dimensional Array and Multidimensional Arrays, Pointer, Pointer to Structure, various Programs for Array and Pointer. Strings. Introduction to Strings, Definition, Library Functions of Strings.	
2	**Stack and Queues**	**06**
2.1	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.	
2.2	Queue, Operations on Queue, Representation of a Queue using array, Circular Queue, concept of priority Queue	
3	**Linked List**	**07**
3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List, Operations on Singly Linked List: Insertion, Deletion, reversal of SLL, Print SLL. Implementation of Stack and Queue using Singly Linked List.	
3.2	Applications of Doubly Linked List and Circular Linked List.	
4	**Trees**	**07**
4.1	Introduction, Tree Terminologies, Binary Tree, Types of Binary Tree, Representation of Binary Trees.	
4.2	Binary Tree Traversals, Binary Search Tree Operations on Binary Search Tree, Applications of Binary Tree – Expression Tree, Huffman Encoding.	
5	**Graphs**	**06**
5.1	Introduction, Graph Terminologies, Representation of graph (Adjacency matrix and adjacency list).	
5.2	Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS), Application – Topological Sorting.	

6	**Introduction to Sorting and Searching**	**08**
6.1	Introduction to Searching: Linear search, Binary search, Sorting: Internal VS. External Sorting	
6.2	Sorting Techniques: Bubble, Insertion, selection, Quick Sort, Merge Sort, Complexity Analysis of Algorithm, Comparison of sorting Techniques based on their complexity.	
6.3	Hashing Techniques, Different Hash functions, Collision & Collision resolution techniques: Linear and Quadratic probing, Double hashing.	
	Total	**39**

Textbooks:	
1	Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education First Edition, 2019.
2	Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson,Second Edition,2017.
3	Data Structures using C, Reema Thareja, Oxford,2nd edition,2014.
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,2nd edition.
Reference books:	
1	Data Structure Using C, Balagurusamy, 4th Edition,2022.
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.
Access to software and virtual labs:	
1	NPTL: Data Structures and Algorithms https://archive.nptel.ac.in/courses/106/102/106102064/
2	NPTL: Programming, Data Structures and Algorithms https://archive.nptel.ac.in/courses/106/106/106106127/

Department of Electronics and Computer Science

DATA STRUCTURE (Lab)

Lab Prerequisite: Knowledge of one or more programming language e.g. C, C++. JAVA, Python and proficiency in any one of them.	
Lab Objectives:	
1	Design and implement Stack ADT using arrays and linked lists, and apply them for expression conversion and evaluation.
2	Implement Linear, Circular, and Priority Queue ADTs using arrays.
3	Build Singly, Doubly, and Circular Linked Lists to manage dynamic data structures efficiently.
4	Construct and traverse Binary Search Trees (BST) using linked representations.
5	Implement graph traversal algorithms including Depth First Search (DFS), Breadth First Search (BFS), and Topological Sorting.
6	Apply searching, sorting, and other data structure algorithms to solve real-world problems.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Build and apply Stack ADTs for arithmetic expression conversions and evaluations.
2	Develop Linear, Circular, and Priority Queues for customized data buffering.
3	Implement dynamic Singly, Doubly, and Circular Linked Lists for efficient memory utilization.
4	Construct Binary Search Trees and perform hierarchical operations.
5	Execute graph traversals (DFS, BFS) and topological sorting on network data.
6	Demonstrate practical programming skills by combining multiple data structures to solve complex computational tasks.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Implement Stack ADT using array.
2	Convert an Infix expression to Postfix expression using stack ADT.
3	Evaluate Postfix Expression using Stack ADT.
4	Applications of Stack ADT.
5	Implement Linear Queue ADT using array.
6	Implement Circular Queue ADT using array.
7	Implement Priority Queue ADT using array.
8	Implement Singly Linked List ADT.
9	Implement Circular Linked List ADT.
10	Implement Doubly Linked List ADT.
11	Implement Stack / Linear Queue ADT using Linked List.
12	Implement Binary Search Tree ADT using Linked List.
13	Implement Graph Traversal techniques: a) Depth First Search b) Breadth First Search
14	Applications of Binary Search Technique.
15	Implementation of Topological sort.

Digital System Design

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC32	Digital System Design (Theory)	03	---	---	03	---	---	03
26ECPCL32	Digital System Design (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Digital Electronics.

Course Objectives:

1	Analyze and design advanced combinational logic circuits using adders, subtractors, multiplexers, demultiplexers, decoders, and MSI components.
2	Understand the operation, conversion, and applications of various flip-flops, registers, and asynchronous/synchronous counters.
3	Design clocked synchronous state machines, state reduction methods, Mealy/Moore models, and sequence detectors.
4	Master the core concepts of Verilog HDL, including data types, operators, structural modeling, and testbench creation.
5	Write Verilog code for complex combinational and sequential systems, including counters, shift registers, and FSMs.
	Evaluate digital logic families (TTL, CMOS) and comprehend FPGA architectures and design flows.

Course Outcomes: After successful completion of the modules, students will be able to:

1	Design and implement complex arithmetic and routing circuits using MSI devices.
2	Build, convert, and troubleshoot flip-flops, registers, and diverse counter configurations.
3	Formulate and analyze synchronous sequential circuits using Mealy and Moore state machine methodologies.
4	Write syntax-compliant Verilog HDL models using continuous and procedural assignments.
5	Simulate and verify digital designs, including combinational blocks, FSMs, and testbenches.
6	Explain the electrical characteristics of logic families and map digital designs onto FPGA hardware flows.

Module	Theory Course Contents	Hrs
1	**Design of Combinational Logic Circuit**	**08**
1.1	Arithmetic Circuits: Half adder, Full adder, Ripple carry adder, Carry Look ahead adder, Half Subtractor, Full Subtractor, multiplexer, cascading of Multiplexer (up to 4:1), Demultiplexer (up to 4:1)	
1.2	Decoder, Comparator Designing using MSI devices: IC7483, IC74151	
2	**Elements of Sequential Logic Design**	**08**
2.1	Sequential Logic: Conversion of flip flops, SR to JK, JK to T, JK to D, D to T Flip Flop. Shift Register- Universal Shift Register.	
2.2	Counters: Asynchronous, Synchronous Counters, Up-Down Counters, Mod Counters, Ring Counter, Twisted ring counter.	
2.3	Sequential logic design practices: MSI 4-bit Binary counter (IC 7490, 7493), MSI Shift register (IC 74194).	
3	**Design of Sequential Logic Circuits**	**06**
3.1	Sequential Logic Design: Mealy and Moore Machines, clocked synchronous state machine analysis, state reduction.	
3.2	Sequence detector, Clocked synchronous state machine design.	
4	**Introduction to Verilog HDL**	**07**
4.1	Basics: Introduction to Hardware Description Language and its core features, synthesis in digital design, logic value system, data types, constants, parameters, wires and registers.	
4.2	Verilog Constructs: Continuous & procedural assignment statements, logical, arithmetic, relational, shift operator, always, if, case, loop statements, Gate level modelling, Module instantiation statements, Test bench, Modelling Examples: Combinational logic, Arithmetic circuits, Multiplexer, Demultiplexer, Decoder.	
5	**Verilog HDL programming for Sequential circuits**	**05**
5.1	Verilog HDL Programming for flip-flops, counters, Shift register	
5.2	Verilog HDL programming for Moore, Mealy type FSMs, Sequence detector	
6	**Logic Families and FPGA**	**05**
6.1	Logic Families: Types of logic families (TTL and CMOS), characteristic parameters (propagation delays, power dissipation, Noise Margin, Fan-out and Fan-in)	
6.2	Zynq APSoC Architecture of ZYBO FPGA/Boolean Board, FPGA design flow: Functional simulation, Timing simulation, Logic synthesis, RTL, Functional Verification.	
	Total	**39**

Textbooks:	
1	M. Morris R. Mano and Michael D. Ciletti, Digital Design with an Introduction to the Verilog HDL, 7th Edition, Prentice Hall of India, India,2020
2	J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing, 2018.
3	Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2nd edition,2006.
Reference books:	
1	M. Morris R. Mano and Michael D. Ciletti, Digital Design with an Introduction to the Verilog HDL, 7th Edition, Prentice Hall of India, India,2020.
2	Stephen Brown and ZvonkoVranesic, Fundamentals of digital logic design with Verilog design, McGraw Hill, 3rd Edition,2013.
3	William I.Fletcher, "An Engineering Approach to Digital Design", PrenticeHall of India,3rd edition,2007.
4	Michael D. Ciletti, Advanced Digital Design with the Verilog HDL,2nd Edition, Pearson Pvt. Ltd, Noida, India,2011.
5	Charles H. Roth, Jr., Fundamentals of Logic Design,7th Edition Reprint, Brooks/Cole, Pacific Grove, US,2014.
Access to software and virtual labs:	
1	https://nptel.ac.in/courses/108105113
2	https://nptel.ac.in/courses/108103179 (For Verilog)
3	https://semiconductorclub.com/online-verilog-compiler/
Industry articles and case studies:	
1	https://www.allaboutcircuits.com/technical-articles/getting-started-with-the-verilog-hardware-description-language/
2	https://www.allaboutcircuits.com/technical-articles/fpga/
3	https://embeddedcomputing.com/technology/processing/semiconductor-ip/fpga-insights-and-trends-2023

Department of Electronics and Computer Science

Digital System Design (Lab)

Lab Prerequisite: Digital Electronics.	
Lab Objectives:	
1	Build and test arithmetic circuits, BCD adders, and logic functions using MSI ICs like 7483 and 74151.
2	Implement flip-flop conversions, MOD-N counters, and sequence detectors using digital hardware components.
3	Write and simulate Verilog HDL code for basic logic gates, arithmetic blocks, and multiplexers.
4	Design, simulate, and verify decoders, comparators, and routing circuits using Verilog.
5	Model and simulate memory elements, shift registers, and multi-bit counters using Verilog HDL.
6	Bridge theoretical digital logic concepts with practical hardware prototyping and HDL simulation workflows.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Construct and troubleshoot combinational arithmetic and routing circuits using standard ICs.
2	Execute flip-flop conversions and configure counters and sequence detectors on hardware.
3	Develop syntax-compliant Verilog code for basic gates and combinational modules.
4	Simulate and verify complex combinational functions like adders, decoders, and comparators.
5	Design and test synchronous sequential components such as counters and shift registers via HDL.
6	Validate digital designs effectively through both physical hardware testing and software simulation environments.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Hardware Based Experiments:	
Sr.No.	**Name of the Experiments**
1	To implement BCD adder using binary adder IC 7483.
2	To implement logic equations using Multiplexer IC 74151.
3	To perform Flip flop conversion JK to D, JK to T and D to T flip flop.
4	To implement MOD N counter using IC 7490/ 7493.
5	To implement Sequence detector.
Software Based Experiments:	
Sr.No.	**Name of the Experiments**
1	To simulate basic logic gates using Verilog HDL.
2	To design and simulate Full adder/full subtractor using Verilog HDL.
3	To design and simulate Multiplexer/Demultiplexer using Verilog HDL.
4	To design and simulate decoder using Verilog HDL.
5	To design and simulate comparator using Verilog HDL.
6	To simulate basic flip flops using Verilog HDL.
7	To design and simulate 4-bit counter / up-down counter using Verilog HDL.
8	To design and simulate Shift register using Verilog HDL.
9	To simulate basic logic gates using Verilog HDL.

Database Management System									
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned				
		TH	PR	Tut	TH	PR	Tut	Total	
26ECPC33	Database Management System (Theory)	03	---	---	03	---	---	03	
26ECPCL33	Database Management System (Lab)	---	02	---	---	01	---	01	
							Total Credits	04	

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Data Structures.	
Course Objectives:	
1	Introduce core database concepts, system architecture, and file system comparisons.
2	Design conceptual data models using ER and EER diagrams.
3	Master the relational model, relational algebra, and schema mapping.
4	Write SQL queries for data definition, manipulation, joins, and views.
5	Apply functional dependencies and normalization (up to BCNF) to optimize database design.
6	Examine transaction management, concurrency control, and recovery mechanisms.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Explain foundational database concepts, architectures, and data independence.
2	Design ER and EER models incorporating entities, attributes, and constraints.
3	Apply relational algebra and map conceptual models to relational schemas.
4	Write SQL queries utilizing DDL/DML commands, joins, aggregates, and triggers.
5	Normalize relational schemas using functional dependencies up to BCNF.
6	Analyze ACID properties, serializability, concurrency control, and recovery protocols.

Module	Theory Course Contents	Hrs
1	**Introduction to Database Concepts**	**03**
1.1	Introduction, Characteristics of databases.	
1.2	File systems v/s Database systems.	
1.3	Data abstraction and Data Independence.	
1.4	DBMS system architecture.	
1.5	Database Administrator.	
2	**Entity–Relationship Data Model**	**07**
2.1	The Entity-Relationship (ER) Model.	
2.2	Entity types: Weak and strong entity sets, Entity sets, Types of Attributes, Keys.	
2.3	Relationship Constraints: Cardinality and Participation.	
2.4	Extended Entity-Relationship (EER) Model: Generalization, Specialization and Aggregation.	
3	**Relational Model and Relational Algebra**	**06**
3.1	Introduction to the Relational Model.	
3.2	Relational schema and concept of keys.	
3.3	Mapping the ER and EER Model to the Relational Model.	
3.4	Relational Algebra – operators, Relational Algebra Queries.	
4	**Structured Query Language (SQL)**	**06**
4.1	Overview of SQL	
4.2	Data Definition Commands	
4.3	Integrity constraints: Key constraints, Domain Constraints, Referential integrity, Check constraints	
4.4	Data Manipulation commands, Data Control commands	
4.5	Set and string operations, aggregate function - group by, having	
4.6	Views in SQL, joins, Nested and complex queries, Triggers	
4.7	MYSQL Functions	
5	**Relational–Database Design**	**07**
5.1	Pitfalls in Relational-Database designs	
5.2	Concept of normalization	
5.3	Function Dependencies	
5.4	First Normal Form, 2NF, 3NF, BCNF.	

6	**Transactions Management and Concurrency and Recovery**	**10**
6.1	Transaction Concept, Transaction states	
6.2	ACID properties	
6.3	Transaction Control Commands	
6.4	Concurrent Executions	
6.5	Serializability: Conflict and View	
6.6	Concurrency Control: Lock-based, Timestamp-based protocols	
6.7	Recovery System: Log based recovery	
6.8	Deadlock handling	
	Total	**39**

Textbooks:	
1	Korth, Slberchatz,Sudarshan, Database System Concepts, 6th Edition, McGraw Hill
2	Elmasri and Navathe, Fundamentals of Database Systems, 7th Edition, Pearson education,2015.
3	Raghu Ramkrishnan and Johannes Gehrke, Database Management Systems, TMH 3rd edition,2003.
Reference books:	
1	Peter Rob and Carlos Coronel, Database Systems Design, Implementation and Management‖, Thomson Learning, 13th edition,2020.
2	Dr.P.S. Deshpande, SQL and PL/SQL for Oracle 10g, Black Book, Dreamtech Press,1st edition,2006.
3	G. K. Gupta, Database Management Systems, McGraw Hill., 2012.
Access to software and virtual labs:	
1	https://nptel.ac.in/courses/106105175
2	http://vlabs.iitkgp.ac.in/se/4/simulation/
Industry articles and case studies:	
1	https://ieeexplore.ieee.org/document/8251067.
2	https://www.researchgate.net/publication/4349094/ Automatic_database_normalization_and_primary_key_generation.

Database Management System (Lab)

Lab Prerequisite: Data Structures	
Lab Objectives:	
1	Implement database structures and enforce integrity constraints using DDL.
2	Perform data manipulation, string operations, and aggregate analysis using DML.
3	Execute complex database queries utilizing multi-table joins and nested subqueries.
4	Program database modules using procedural extensions, views, triggers, and control commands.
5	Establish database connectivity and test transaction concurrency control with locking techniques.
6	Implement database structures and enforce integrity constraints using DDL.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Construct ER/EER diagrams and translate conceptual models into structured relational schemas.
2	Create and manage database tables and integrity constraints using SQL DDL.
3	Manipulate data and extract insights using advanced SQL queries, functions, and string operations.
4	Write complex queries involving inner/outer joins and nested subqueries to retrieve specific datasets.
5	Develop stored procedures, functions, views, triggers, and manage sessions using DCL/TCL.
6	Integrate databases with external applications and simulate transaction concurrency control protocols.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Identify the case study and detail statement of problem. Design an Entity-Relationship (ER) / Extended Entity-Relationship (EER) Model.
2	Mapping ER/EER to Relational schema model.
3	Create a database using Data Definition Language (DDL) and apply integrity constraints for the specified System
4	Apply DML Commands for the specified system
5	Perform Simple queries, string manipulation operations and aggregate functions.
6	Implement various Join operations.
7	Perform Nested and Complex queries.
8	Perform DCL and TCL commands.
9	Implement procedure and functions
10	Implementation of Views and Triggers.
11	Demonstrate Database connectivity.
12	Implementation and demonstration of Transaction and Concurrency control techniques using locks.

Microprocessor and Microcontroller

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECMM31	Microprocessor and Microcontroller (Theory)	03	---	---	03	---	---	03
26ECMML31	Microprocessor and Microcontroller (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Digital Electronics.

Course Objectives:

1	Introduce 8086 architecture, memory segmentation, and interrupts.
2	Explain 8086 addressing modes, instruction sets, and directives.
3	Examine 8086 operating modes, clock generators, and memory interfacing.
4	Compare microprocessors and microcontrollers, detailing 8051 architecture.
5	Develop 8051 assembly and embedded C programs for peripherals.
6	Implement 8051 I/O ports, timers, serial communication, and device interfacing.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Explain 8086 architecture, pin descriptions, and interrupt handling.
2	Write assembly programs using 8086 addressing modes and instructions.
3	Design 8086 system modules with clock generators and memory chips.
4	Analyze internal architecture and memory organization of the 8051.
5	Develop assembly and embedded C programs for 8051 applications.
6	Interface I/O devices, timers, and serial ports with the 8051.

Module	Theory Course Contents	Hrs
1	**The 8086 Microprocessor**	**06**
1.1	Introduction of 8085 microprocessor.	
1.2	8086 Architecture	
1.3	Memory Segmentation and Memory Banking	
1.4	8086 pin description	
1.5	Interrupts and Interrupt service routines, Dedicated interrupts, Software interrupts	
2	**8086 Programming**	**05**
2.1	Addressing modes	
2.2	Instruction Set and Assembler Directives	
3	**8086 Interfacing –Part I**	**06**
3.1	Generating the 8086 System Clock and Reset Signals using 8284 clock generators	
3.2	8086 Minimum and Maximum Mode CPU Modules	
3.3	Memory interfacing	
4	**The 8051 Microcontroller**	**04**
4.1	Differences between a Microprocessor and Microcontroller	
4.2	Architecture of 8051	
4.3	Memory Organization of the 8051	
5	**8051 Programming**	**09**
5.1	Addressing modes	
5.2	Instruction set	
5.3	Assembly language programming-ADD/SUB/MUL/DIV/Smallest /largest/ascending order	
5.4	C Programming-program on LED blinking, seven segment interface, LCD interface and Stepper motor interface	
6	**8051 Interfacing**	**09**
6.1	I/O port programming	
6.2	Programming 8051 Timers	
6.3	Serial Port Programming	
6.4	IO Interfacing - Keypad interface, ADC & DAC interface,	
6.5	Introduction to 8051 variants Atmega 8, Nuvoton MS51	
	Total	**39**

Textbooks:	
1	8086/8088 family: Design Programming and Interfacing: By John Uffenbeck (Pearson Education),3rd edition,2002.
2	Microprocessor and Interfacing: By Douglas Hall (TMH Publication),3rd edition,2017.
3	The 8051 Microcontroller and Embedded Systems Using Assembly and C: By M. A. Mazidi, J. C. Mazidi, Rolin D. McKinlay, Pearson Education, 2nd edition,2007.
Reference books:	
1	Microcomputer Systems: 8086/8088 family Architecture, Programming and Design: By Liu & Gibson (PHI Publication),2nd edition,2004.
2	The 8051 Microcontroller: By Kenneth J. Ayala, Cengage Learning India Pvt. Ltd, 3rd edition.
3	The INTEL Microprocessors, Architecture, Programming and Interfacing: By Barry B. Brey (Pearson Publishers, 8th Edition).
4	Microcontrollers: Architecture, Programming, Interfacing and System Design: By RajKamal, Pearson Education, 2005.
Access to software and virtual labs:	
1	https://archive.nptel.ac.in/courses/108/105/108105102/
2	https://archive.nptel.ac.in/courses/108/103/108103157/
3	http://www.kitektechnologies.com/images/prod/mp5.pdf
Industry articles and case studies :	
1	https://www.tutorialspoint.com/microprocessor/microprocessor_8086_overview.htm
2	https://www.keil.com/dd/chips/all/8051.htm
3	https://www.keil.com/dd/chips/all/8051.htm

Department of Electronics and Computer Science

Microprocessor and Microcontroller (Lab)

Lab Prerequisite: C-Programming, Digital Electronics.	
Lab Objectives:	
1	Implement arithmetic and logical operations using 8086 microprocessor assembly language.
2	Program the 8051 microcontroller for data transfer, arithmetic, logical operations, and subroutines.
3	Configure and utilize 8051 I/O ports for basic input/output interfacing with LEDs and switches.
4	Implement serial port communication protocols using the 8051 microcontroller.
5	Utilize 8051 timer interrupts and peripheral configurations for time-based operations.
6	Interface external hardware like LCDs, ADCs, DACs, keypads, and various motors (DC, stepper, servo) with the 8051.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Write and execute assembly language programs for basic 8086 computational tasks.
2	Develop and debug software routines for the 8051 microcontroller.
3	Connect and control basic input/output devices such as switches and LEDs using microcontroller ports.
4	Execute serial data transmission and manage internal timers for precise operations.
5	Interface sensors, ADCs, and DACs to process analog signals.
6	Control complex peripherals including alphanumeric displays, keypads, and DC/stepper/servo motors.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Arithmetic Operations, Logical operations (using 8086)
2	Data Transfer, Arithmetic, Logical operations using 8051
3	Use of Subroutine in 8051 Programming
4	IO Port Programming using 8051
5	Interfacing of led, switch with 8051
6	Serial port programming of 8051
7	Applications of Timers of 8051
8	LCD Interfacing (using 8051)
9	Sensor interfacing using an ADC (using 8051)
10	Generation of different waveforms using DAC (using 8051)
11	Interfacing of Keypad with 8051
12	Interfacing of DC, Stepper, servo motors with 8051.

Finance Management for Engineers

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECEM31	Finance Management for Engineers (Theory)	02	---	---	02	---	---	02
							Total Credits	**02**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	--	30	--	--	50

Course Objectives:	
1	To know about the Indian financial system, instruments, and market.
2	To understand the relationship between risk, return, and time value of Money.
3	To understand the financial statements and ratio analysis.
4	To understand personal taxation.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Explain the Indian financial system, instruments, and market.
2	Determine the risk, return, and time value of Money with respect to financial decisions.
3	Decide investment decisions for projects with the help of financial ratios.
4	Determine the components involved in taxation.

Module	Theory Course Contents	Hrs
1	**Indian Financial System**	**08**
1.1	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, Treasury Bills, Trade credit.	
1.2	Financial Markets: Meaning, Characteristics and Classification of Financial Markets — Capital Market, Money Market and Foreign Currency Market.	
1.3	Financial Institutions: Meaning, Characteristics and Classification of Financial Institutions: Commercial Banks, Investment-Merchant Banks and Stock Exchanges.	
2	**Financial Risk and Returns**	**06**
2.1	Concepts of Returns and Risks: Measurement of Historical Returns and Expected Returns of a Single Security and a Two-security Portfolio.	
2.2	Measurement of Historical Risk and Expected Risk of a Single Security and a Two-security Portfolio.	
2.3	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.	
3	**Corporate Finance**	**06**
3.1	Overview of Financial Statements: Balance Sheet, Profit and Loss Account, and Cash Flow Statement.	
3.2	Financial Ratio Analysis: Purpose of Financial Ratio Analysis. Liquidity Ratios; Efficiency or Activity Ratios; Profitability Ratios; Capital Structure Ratios; Stock Market Ratios; Limitations of Ratio Analysis.	
4	**Introduction To Taxation**	**06**
4.1	Introduction and Objectives, Assessment Year, Previous Year, Person	
4.2	Assessee, Assessment, Income	
4.3	Gross Total Income, Total Income, Scheme of charging income tax	
	Total	**26**

Reference books:

1	Fundamentals of Financial Management, 13th Edition (2015) by Eugene F. Brigham and Joel F. Houston; Publisher: Cengage Publications, New Delhi.
2	Analysis for Financial Management, 10th Edition (2013) by Robert C. Higgins; Publishers: McGraw Hill Education, New Delhi.
3	Indian Financial System, 9th Edition (2015) by M. Y. Khan; Publisher: McGraw Hill Education, New Delhi.
4	Financial Management, 11th Edition (2015) by I. M. Pandey; Publisher: S. Chand (G/L) & Company Limited, New Delhi.

Professional Communication and Ethics - II								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECAE31	Professional Communication and Ethics (Theory)	01	---	---	01	---	---	01
26ECAEL31	Professional Communication and Ethics (Lab)	---	02	---	---	01	---	01
							Total Credits	**02**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
--	--	--	50	--	50
Note-This course is evaluated as a term work by the tools suggested below.					

Course Prerequisite: Professional Communication and Ethics-I.	
Course Objectives:	
1	To discern and develop an effective style of writing important technical/business documents.
2	To investigate possible resources and plan a successful job campaign.
3	To understand the dynamics of professional communication in the form of group discussions, meetings, etc. required for career enhancement.
4	To develop creative and impactful presentation skills.
5	To analyze personal traits, interests, values, aptitudes and skills.
6	To understand the importance of integrity and develop a personal code of ethics.
Course Outcomes: After successful completion of the modules, students will be able to:	
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.

Module	Theory Course Contents	Hrs
1	**Advanced Technical Writing: Project/Problem Based Learning (PBL)**	**06**
1.1	Definition, Purpose & Types of Proposals: Solicited & Unsolicited Proposals, Types (Short and Long proposals)	
1.2	Parts of a Proposal: Elements, Scope and Limitations, Conclusion	
1.3	Objectives of Report Writing: Information, Decision Making, Analysis, Recommendations	
1.4	Parts of a Long Formal Report: Prefatory Parts (Front Matter), Report Proper (Main Body), Appended Parts (Back Matter)	
1.5	Language and Style of Reports: Tense, Person & Voice of Reports, Numbering Style of Chapters, Sections, Figures, Tables, Referencing Styles in APA & MLA Format Proofreading through Plagiarism Checkers	
1.6	Technical Paper Writing: Parts of a Technical Paper, Language and Formatting, Writing an abstract Referencing in IEEE Format	
1.7	Presenting data-figures, diagrams and labelling, Graphic Organizers for Summaries, Radial Diagrams like Mind Maps, Flow Charts, Cyclic Diagrams, Linear Diagrams like Timelines, Pyramids, Venn Diagrams	
2	**Employment Skills**	**06**
2.1	Cover Letter & Resume: Parts and Content of a Cover Letter, Difference between Bio-data, Resume & CV, Essential Parts of a Resume, Types of Resumes - Chronological, Functional & Combination	
2.2	Statement of Purpose: Importance of SOP, Tips for Writing an Effective SOP	
2.3	Group Discussions: Purpose of a GD, Parameters of Evaluating a GD, Types of GDs - Normal, Case-based & Role Plays, GD Etiquettes	
2.4	Personal Interviews: Planning and Preparation, Types of Questions, Types of Interviews - Structured, Stress, Behavioural, Problem Solving & Case-based, Modes of Interviews - Face-to-face (One-to one and Panel), Telephonic, Virtual	

3	**Business Meetings**	**02**
3.1	Documentation: Notice, Agenda, Minutes	
3.2	Conducting Business Meetings: Types of Meetings, Roles and Responsibilities of Chairperson, Secretary and Members Meeting Etiquette	
4	**Technical/ Business Presentations**	**02**
4.1	Effective Presentation Strategies, Defining Purpose, Analyzing Audience, Location and Event, Gathering, Selecting and Arranging Material, Structuring a Presentation, Making Effective Slides, Types of Presentations Aids, Closing a Presentation, Platform skills	
4.2	Group Presentations: Sharing Responsibility in a Team, Building contents and visuals together, Transition Phases	
5	**Interpersonal Skills**	**05**
5.1	Interpersonal Skills: Emotional Intelligence, Leadership & Motivation, Conflict Management & Negotiation, Time Management, Assertiveness, Decision Making	
6	**Corporate Ethics**	**02**
6.1	Intellectual Property Rights: Copyrights, Trademarks, Patents, Industrial Designs	
6.2	Case Studies: Cases related to Business/ Corporate Ethics	
7	**Professional Writing Skills**	**03**
7.1	Developing Professional Writing Skills: Effective introduction with emphasis on general statement, opposing statement and thesis statement Critical response to a text with special reference to purpose, evaluation of the content, theme and style of a text Organization of ideas, sentence construction and word choice, grammar and usage Explanation and support of ideas (special reference to writing paragraphs opening statement, body, closing statement, linkers)	
7.2	Creative Writing: Narrative essays, Content writing, Blog	

Reference books:	
1	Lesiker and Petit (1997), "Report Writing for Business", McGraw-Hill Education10th edition.
2	Butterfield, J. (2017). Verbal communication: Soft skills for a digital workplace. Boston, MA: Cengage Learning.
3	Bovée, C. L., & Thill, J. V. (2017). Business communication today, 14th Edition, NJ: Pearson.
4	Robbins, S. P., Judge, T. A., & Campbell, T. T. (2017). Organizational Behaviour. Harlow,England: Pearson.
5	Fred Luthans. (2010). Organizational Behavior, McGraw Hill Education, 12th edition.
6	B N Ghosh (2017), Managing Soft Skills for Personality Development, Tata McGraw Hill Education.
7	R. C. Sharma, Krishna Mohan, Virendra Singh Nirban (2020). Business Correspondence and Report Writing, 6th Edition, McGraw Hill
8	Julie-Ann Amos (2004). Handling Tough Job Interviews Jaico Publishing House
References: Web Links	
1	http://networketiquette.net/
2	https://public.wsu.edu/~brians/errors/
3	http://users3.ev1.net/~pamthompson/body_language.htm
4	http://www.albion.com/netiquette/corerules.html
5	http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/1535_questionanswer/page15.shtml
6	http://www.colostate.edu/Depts/Speech/rccs/theory44.html
7	http://www.dailywritingtips.com

Term Work:

Term work will be for 50-Marks as given below

Sr No	Headings	Marks
A	Assignments	10 Marks
B	Mini Project with Presentation	10 Marks
C	Media Studies	10 Marks
D	Book Report and Presentation	10 Marks
E	Group Discussion	10 Marks
Total		**50 Marks**

A) Assignments: List of assignments are as given below. The assignments have to be discussed in the group and approved by faculty. Each student in the group will have to write the assignments individually (10 Marks):

Sr No	List of Assignments
1	Resume, Cover Letter and SOP
2	Summarizing data figures into paragraphs (Module 1.7)
3	Notice, Agenda and Minutes of Meeting
4	Two case studies on Business Ethics
5	Assignment on (Teamwork, Leadership, Decision Making and Problem Solving)

B) Report on presentation: A detail typed report has to be prepared of minimum 25 pages and maximum 30 pages. The format of the report has to be discussed and approved by faculty

C) A final Group Discussion Round will be conducted and every student must participate in the group discussion

Department of Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-IV
A.Y. 2026-27

Course Type	Semester IV Teaching Scheme (AY 2026-27)									
	Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned				
			TH	PR	TUT	TH	PR	TUT	Total
PCC	26ECPC41/ 26ECPCL41	Electronic Devices and Circuits	3	2	---	3	1	---	4
PCC	26ECPC42/ 26ECPCL42	Operating Systems	2	2	---	2	1	---	3
PCC	26ECPC43/ 26ECPCL43	Signal & Systems	2	2	---	2	1	---	3
MDM	26ECMM41/ 26ECMML41	Embedded System and RTOS	3	2	---	3	1	---	4
OE	26ECOE14X	Open Elective (NPTEL MOOC Course)	##	---	---	##	---	---	4
EM	26ECEM41	Introduction to Innovation and Entrepreneurship for Engineers	---	---	2	---	---	2	2
VSEC	26ECVSEL41	Full Stack Development	---	4	---	---	2	---	2
FP	26ECFP41	Field Projects	---	4	---	---	2	---	2
	Total Credits								**24**

- Students are required to complete a 12 weeks MOOC course from the suggested list recommended by the department.

Course Type	Semester IV Examination Scheme							
	Course Code	Course Name	TH	MT	CA	TW	PR/ OR	Total
PCC	26ECPC41/ 26ECPCL41	Electronic Devices and Circuits	60	20	20	25	25	150
PCC	26ECPC42/ 26ECPCL42	Operating Systems	60	20	20	25	25	150
PCC	26ECPC43/ 26ECPCL43	Signal & Systems	60	20	20	25	25	150
MDM	26ECMM41/ 26ECMML41	Embedded System and RTOS	60	20	20	25	25	150
OE	26ECOE4X	Open Elective (NPTEL MOOC Course)	##					100
EM	26ECEM41	Introduction to Innovation and Entrepreneurship for Engineers	---	---	---	25	---	25
VSE	26ECVSEL41	Full Stack Development	---	---	---	25	25	50
FP	26ECFP41	Field Projects	---	---	---	25	25	50
	Total Marks							**825**

Electronic Devices and Circuits									
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECPC41	Electronic Devices and Circuits (Theory)	03	---	---	03	---	---	03
26ECPCL41	Electronic Devices and Circuits (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite: Basic Electrical and Electronics Engineering.	
Course Objectives:	
1	Understand semiconductor device physics and characteristics (diodes, BJTs, MOSFETs).
2	Analyze DC and AC performance, biasing, and small-signal models of transistor amplifiers.
3	Evaluate low and high-frequency responses of MOSFET amplifiers, including parasitic and Miller effects.
4	Examine the fundamentals of differential amplifiers and operational amplifier (Op-Amp) parameters.
5	Design linear and non-linear Op-Amp circuits, including filters, arithmetic blocks, and triggers.
6	Apply special-purpose ICs, such as the 555 timer and voltage regulators, in practical designs.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Analyze diode configurations, BJTs, and E-MOSFET characteristics using DC load lines and biasing.
2	Perform small-signal AC analysis on common-source MOSFET amplifiers.
3	Assess low and high-frequency responses using coupling, bypass, and Miller capacitances.
4	Explain differential amplifiers and ideal/practical Op-Amp specifications.
5	Design Op-Amp applications including arithmetic circuits, integrators, and comparators.
6	Configure special-purpose ICs like the 555 timer and linear voltage regulators.

Department of Electronics and Computer Science

Module	Theory Course Contents	Hrs
1	**PN junction diode applications and Introduction to BJT**	**06**
1.1	Application of P-N junction diode as clippers & clampers (different types of configurations with input-output waveforms & transfer characteristics).	
1.2	BJT construction & structure, symbol, operation, V-I characteristics of common emitter configuration. DC Circuit Analysis: DC load line, Q-point & region of operation, concept of biasing, bias stability, analysis of CE amplifier using voltage divider biasing circuit. (numerical examples to be included).	
2	**Metal Oxide Semiconductor Field Effect Transistor (MOSFET)**	**06**
2.1	MOSFET: Types, Construction, operation, symbol, V-I & transfer characteristics of the E-MOSFET.	
2.2	DC Circuit Analysis: DC load line, Q-point & region of operation, common MOSFET configurations of common source (CS), analysis of biasing circuits (only CS configuration using voltage divider biasing) (numerical examples only for E-MOSFET).	
3	**AC Analysis and Frequency Response of Amplifier**	**08**
3.1	AC analysis of MOSFET: Small signal (AC) model of MOSFET & its equivalent circuit, small signal analysis of Common source (CS) configuration MOSFET amplifier only (Numerical examples included).	
3.2	Low frequency response & analysis, effect of the coupling, bypass & load capacitances on single stage MOSFET amplifier for common source (CS) configuration (mathematical analysis & numerical examples included).	
3.3	High frequency response & analysis, effect of parasitic capacitances in MOSFET amplifier, high frequency equivalent circuit of MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth (mathematical analysis & numerical examples included).	
4	**Introduction to Differential amplifier and Operational Amplifier**	**06**
4.1	MOSFET differential amplifier, types, DC characteristics, Transfer characteristics	
4.2	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, Virtual ground and virtual short circuit concept, IC 741 pin diagram & description.	
5	**Applications of Operational Amplifier**	**07**
5.1	Inverting amplifier, Non-inverting amplifier, Summing amplifier, Difference amplifier, Ideal and practical integrator, ideal and practical differentiator.	

5.2	Comparators: Inverting comparator, non-inverting comparator, zero crossing detector (ZCD) & Schmitt Trigger	
6	**Special Purpose Integrated Circuits**	**06**
6.1	IC 555 timer internal block diagram & pin configuration, operation in astable & monostable multivibrator with mathematical analysis & numerical examples.	
6.2	Voltage regulator IC 78XX, IC 723 (Low voltage low current and High voltage low current application)	
	Total	**39**

Textbooks:	
1	Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 3rd Edition,2006.
2	David A. Bell, "Electronic Devices and Circuits", Oxford, 7th Edition,2009.
3	Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", Pearson, revised 4th Edition,2021.
Reference books:	
1	Boylestead," Electronic Devices and Circuit Theory", Pearson Education,12th Edition,2021.
2	Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, 7th Edition,2017.
3	Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage,3rd edition,2016.
4	S. Salivahanan, N. Suresh Kumar,"Electronic Devices and Circuits", Tata McGraw Hill,5th edition,2022.
5	Sergio Franco, "Design with operational amplifiers & analog integrated circuits", Tata McGraw Hill, 4th edition,2016.
6	D. Roy Choudhury and S. B. Jain, "Linear Integrated Circuits", New Age International Publishers, 5th Edition,2018.
Access to software and virtual labs:	
1	LTspice software - https://www.analog.com/en/resources/design-tools-and-calculators/ltspice-simulator.html
2	https://www.pspice.com/
3	Virtual lab-http://vlabs.iitkgp.ac.in/be/
4	https://onlinecourses.nptel.ac.in/noc24_ee99/preview
Industry articles and case studies:	
1	https://www.researchgate.net/topic/Electronic-Circuit-Design/publications
2	https://circuitdigest.com/tech-articles
3	https://www.azom.com/article.aspx?ArticleID=22700

4	https://www.researchgate.net/topic/Operational-Amplifiers/publications
5	https://www.electronicsforu.com/
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	https://www.collegelib.com/artificial-intelligence-in-electronics/
2	https://www.snapmagic.com/

Electronic Devices and Circuits (Lab)

Lab Prerequisite: Basic Electrical and Electronics Engineering.	
Lab Objectives:	
1	Build and test arithmetic circuits, BCD adders, and logic functions using MSI ICs like 7483 and 74151.
2	Implement flip-flop conversions, MOD-N counters, and sequence detectors using digital hardware components.
3	Write and simulate Verilog HDL code for basic logic gates, arithmetic blocks, and multiplexers.
4	Design, simulate, and verify decoders, comparators, and routing circuits using Verilog.
5	Model and simulate memory elements, shift registers, and multi-bit counters using Verilog HDL.
6	Bridge theoretical digital logic concepts with practical hardware prototyping and HDL simulation workflows.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Construct and troubleshoot combinational arithmetic and routing circuits using standard ICs.
2	Execute flip-flop conversions and configure counters and sequence detectors on hardware.
3	Develop syntax-compliant Verilog code for basic gates and combinational modules.
4	Simulate and verify complex combinational functions like adders, decoders, and comparators.
5	Design and test synchronous sequential components such as counters and shift registers via HDL.
6	Validate digital designs effectively through both physical hardware testing and software simulation environments.
Suggested Experiments: Students are required to complete at least 10 experiments. At least 50% experiments should be Simulation based.	
Sr.No.	**Suggested Experiments** (Hardware and Simulation based)
1	To perform Clippers and Clampers.
2	To perform DC analysis of CE amplifier in voltage divider configuration.
3	To perform DC analysis of CS MOSFET amplifier in voltage divider configuration.
4	To perform AC analysis of CE amplifiers (Calculate Av, Ai, Ri, Ro).
5	To analyze the frequency response of CS amplifier.
6	To design Inverting and Noninverting amplifier using IC 741.
7	To design of linear application using op amp IC 741 (eg. adder/ subtractor, Integrator, Differentiator etc)
8	To design nonlinear applications of opamp IC 741 (eg. Comparator, zero crossing detector, Schmitt trigger etc..)
9	To design Monostable/Astable multivibrator using IC 555
10	To design voltage regulator using IC 723

Operating System

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC42	Operating System (Theory)	02	---	---	02	---	---	02
26ECPCL42	Operating System (Lab)	---	02	---	---	01	---	01
							Total Credits	03

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Objectives:	
1	To understand the major components of the Operating System and its functions.
2	To introduce the concept of a process and its management like transition, scheduling, etc.
3	To understand basic concepts related to Inter-process Communication (IPC) like mutual exclusion, deadlock, etc. and role of an Operating System in IPC.
4	To understand the concepts and implementation of memory management policies and virtual memory.
5	To understand functions of Operating Systems for storage management and device management.
6	To study the need and fundamentals of special-purpose operating system with the advent of new emerging technologies.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Understand the basic concepts related to Operating Systems.
2	Comprehend Process management policies and scheduling of processes by CPU.
3	Understand various concepts involved in Process Coordination.
4	Understand the memory allocation and management functions of Operating Systems.
5	Understand the services provided by the Operating System for storage management.
6	Compare the functions of various special-purpose Operating Systems.

Module	Theory Course Contents	Hrs
1	**Fundamentals of Operating System**	**03**
1.1	Introduction to Operating Systems; Operating System Structure-Layered, Monolithic, Microkernel operating system; Functions of Operating Systems; Operating System Services and Interface; System Calls and its Types; System Programs; Operating System Structure.	
1.2	Self-learning Topics: Study of any three different OS. System calls with examples for different OS.	
2	**Process Management**	**05**
2.1	Basic Concepts of Process; Operation on Process; Process State Model and Transition; Process Control Block; Context Switching; Introduction to Threads; Types of Threads, Thread Models; Basic Concepts of Scheduling; Types of Schedulers; Scheduling Criteria; Scheduling Algorithms and performance evaluation of the scheduling.	
2.2	Self-learning Topics: Performance comparison of Scheduling Algorithms, Selection of Scheduling Algorithms for different situations, Real-time Scheduling.	
3	**Process Coordination**	**05**
3.1	Basic Concepts of Inter-process Communication and Synchronization; Race Condition; Critical Region and Problem; Peterson's Solution; Synchronization Hardware and Semaphores; Monitors, Classic Problems of Synchronization; Message Passing; Introduction to Deadlocks; System Model, Deadlock Characterization; Deadlock Detection and Recovery; Deadlock Prevention; Deadlock Avoidance.	
3.2	Self-learning Topics: Study a real time case study for Deadlock detection and recovery.	
4	**Memory Management**	**05**
4.1	Basic Concepts of Memory Management; Logical and Physical address map, swapping; Memory Allocation: Contiguous memory allocation, Fixed and variable partition. Internal and External fragmentation and compaction; Paging; Structure of Page Table; Segmentation; Basic Concepts of Virtual Memory; Demand Paging, Page Replacement Algorithms; Thrashing.	
4.2	Self-learning Topics: Memory Management for any one Operating System, Implementation of Page Replacement Algorithms.	
5	**Storage Management**	**04**
5.1	Basic Concepts of File System; File Access Methods; Directory Structure; File-System Implementation; Allocation Methods; Free Space Management; Overview of Mass-Storage Structure; Disk Structure; Disk Scheduling; RAID Structure; Introduction to I/O Systems.	
5.2	Self-learning Topics: File System for Linux and Windows, Features of I/O facility for different OS.	

6	**Special-purpose Operating Systems**	**04**
6.1	Open-source and Proprietary Operating System; Fundamentals of Distributed Operating System; Network Operating System; Cloud and IoT Operating Systems; Real-Time Operating System; Mobile Operating System; Multimedia operating System; Comparison between functions of various Special-purpose Operating Systems.	
6.2	Self-learning Topics: Case Study on any one Special-purpose Operating Systems.	
	Total	**26**

Textbooks:	
1	A. Silberschatz, P. Galvin, G. Gagne, Operating System Concepts, 10th ed., Wiley, 2018.
2	W. Stallings, Operating Systems: Internal and Design Principles, 9th ed., Pearson, 2018.
3	A. Tanenbaum, Modern Operating Systems, Pearson, 4th ed., 2015.
Reference books:	
1	N. Chauhan, Principles of Operating Systems, 1st ed., Oxford University Press, 2014.
2	A. Tanenbaum and A. Woodhull, Operating System Design and Implementation, 3rd ed., Pearson,2006.
3	R. Arpaci-Dusseau and A. Arpaci-Dusseau, Operating Systems: Three Easy Pieces, CreateSpace Independent Publishing Platform, 1st ed., 2018.
Access to software and virtual labs:	
1	https://nptel.ac.in/courses/106105214
2	https://naim30.github.io/OS-virtual-lab/
Industry articles and case studies:	
1	https://www.ijcaonline.org/archives/volume176/number39/adekotujo-2020-ijca-920494.pdf
2	https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID3820615_code1673756.pdf?abstractid=3820615&mirid=1
3	https://www.acs.eonerc.rwth-aachen.de/cms/E-ON-ERC-ACS/Studium/Lehrveranstaltungen/~lrhs/Spezial-Betriebssysteme/lidx/1/

Operating System (Lab)

Lab Prerequisite: C-Programming.	
Lab Objectives:	
1	To learn Unix general purpose commands and programming in the Unix editor environment.
2	To understand file system management and user management commands in Unix.
3	To understand process management and memory management commands in Unix.
4	To learn basic shell scripting.
5	To understand different process scheduling algorithms.
6	To understand different memory management algorithms.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Identify the Unix general purpose commands.
2	Apply Unix commands for system administrative tasks such as file system management and user management.
3	Execute Unix commands for system administrative tasks such as process management and memory management.
4	Demonstrate basic shell scripts for different applications.
5	Analyze different process scheduling algorithms.
6	Analyze different memory management algorithms.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	To study network components.
2	To build a simple client-server model in NS-2, demonstrating TCP or UDP-based communication.
3	To study the working of wireshark, a packet sniffing tool, and analyze network traffic using sniffing technique.
4	To understand and implement socket programming using NetSim for communication between client and server.
5	To view, add, delete, and modify routing tables and configure IP forwarding using IP tables in Windows operating systems.
6	Use a tool (Eg. NS2) to implement a specific Network topology with respect to the given number of nodes and physical configuration and do: ● Graphical simulation of network with Routing Protocols and traffic consideration (TCP, UDP) ● Analysis of network performance for quality parameters such as packet-delivery-ratio, delay, and throughput
7	Set up and configuration of firewalls in Linux/windows (Use IP Tables)

8	To install and configure the WiMAX module in NS-2 and study how varying the symbol rate (low vs. high) affects throughput, latency, and packet loss.
9	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP,ip, ifconfig, dig, route, etc) and set up a network environment with multiple IP addresses and configuration of ARP tables. Set up a network environment in Windows platform also.
10	Working with routing in Linux: ● View the current routing table ● Add and delete routes ● Change default gateway Perform IP Tables for IP forwarding.
11	Configure and simulate either a Bluetooth or ZigBee network in NS-2. To compare key performance metrics (throughput, range, power consumption) with other wireless technologies (Wi-Fi, MANET). To examine how different topologies (star, mesh) and superframe structures (in ZigBee) influence network behavior.
12	To implement and analyze a Wireless Sensor Network using the LEACH protocol in NS-2. To study energy consumption, network lifetime, and packet delivery under various node densities and clustering scenarios. To explore the "new" wireless trace file format in NS-2 for gathering detailed WSN simulation metrics.

Signals And Systems

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC43	Signals And Systems (Theory)	02	---	---	02	---	---	02
26ECPCL43	Signals And Systems (Lab)	---	02	---	---	01	---	01
							Total Credits	03

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Proficiency in calculus, ordinary differential equations, complex numbers, and Euler's formula. Fundamental knowledge of RLC circuits and basic programming (Python or MATLAB) for system analysis.

Course Objectives:

1	Understand the mathematical representation, classification, and operations of continuous-time and discrete-time signals and systems.
2	Analyze Linear Time-Invariant (LTI) systems using time-domain techniques like convolution and correlation.
3	Examine continuous-time systems in the frequency domain using the Laplace transform and ROC concepts.
4	Evaluate discrete-time systems using bilateral and unilateral Z-transforms and pole-zero mapping.
5	Determine the frequency characteristics of continuous-time signals using Fourier series and Fourier transforms.
6	Investigate discrete-time signals through Discrete-Time Fourier Series (DTFS) and Discrete-Time Fourier Transform (DTFT).

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Classify continuous-time and discrete-time signals and systems, applying signal transformations and the sampling theorem.
2	Analyze LTI systems in the time domain using convolution integrals, convolution sums, and system properties.
3	Evaluate continuous-time system stability, causality, and step responses using the Laplace transform.
4	Characterize discrete-time LTI systems in the z-domain using Z-transforms and pole-zero locations.
5	Compute Fourier series and Fourier transforms of continuous-time signals to study their frequency spectrum.
6	Analyze discrete-time signals and compute magnitude/phase responses using DTFS and DTFT.

Module	Theory Course Contents	Hrs
1	**Continuous and Discrete Time Signals and Systems**	**07**
1.1	Mathematical Representation and Classification of Continuous Time CT) and Discrete Time (DT) Signals Arithmetic Operations on Signals, Time Shifting, Time Scaling, Time Reversal of Signals, Sampling Theorem and Aliasing.	
1.2	Mathematical Representation and Classification of CT systems	
1.3	Mathematical Representation and Classification of DT systems	
2	**Time Domain Analysis of Continuous And Discrete Signals and Systems**	**07**
2.1	Properties of Linear Time Invariant (LTI) systems, Impulse and Step Response	
2.2	Use of Convolution Integral and Convolution Sum and Correlation for Analysis of LTI Systems	
2.3	Properties of Convolution Integral/Sum	
3	**Frequency Domain Analysis of Continuous Time System using Laplace Transform**	**03**
3.1	Review of Laplace Transform and Inverse Laplace Transform, Concept of ROC,Poles and Zeros	
3.2	Analysis and characterization of LTI system using Laplace transform: impulse and step response, causality, stability, stability of causal system	
4	**Frequency Domain Analysis of Discrete Time System using Z Transform**	**03**
4.1	Review of Z Transform, Properties of Unilateral and Bilateral Z Transform, Mapping with s Plane.	
4.2	Analysis and Characterization of LTI System Using Z Transform: Impulse and Step Response, Causality, Stability in z-Domain.	
5	**Frequency Domain Analysis of Continuous Time Signals**	**03**
5.1	Fourier Series of Continuous Time Signals	
5.2	Fourier Transform of Standard Signals, Relationship Between Fourier and Laplace Transform	
6	**Frequency Domain Analysis of Discrete Time Signals**	**03**
6.1	Concept of Discrete Time Fourier Series, Properties of DTFS , Discrete Time Fourier Transform and Determination of Magnitude and Phase Functions using DTFT	
	Total	**26**

Textbooks:	
1	Tarun Kumar Rawat, "Signals and Systems", Oxford University Press, 2016.
2	A. Nagoor Kani, "Signals and Systems", Tata McGraw-Hill Education, 2014.
Reference books:	
1	John Proakis and Dimitris Monolakis, "Digital Signal Processing", Pearson Publications, 4th Edition, 2006.
2	Alan V. Oppenheim, AlanS. Willsky, and S.Hamid Nawab, "Signals and Systems", 2nd Edition,PHI learning, 2010
3	B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2nd Edition, 2006.

Signals and Systems (Lab)

Lab Objectives:	
1	To study and classify continuous-time and discrete-time signals and systems using mathematical representations and graphical analysis.
2	To perform arithmetic operations, time shifting, time scaling, and time reversal on CT and DT signals and verify their effects practically.
3	To analyze Linear Time Invariant (LTI) systems using convolution integral, convolution sum, impulse response, and step response techniques.
4	To apply Laplace Transform and Z-Transform methods for solving and analyzing continuous-time and discrete-time systems.
5	To investigate frequency-domain characteristics of signals using Fourier Series, Fourier Transform, DTFS, and DTFT techniques.
6	To study sampling theorem, aliasing effects, system stability, causality, and frequency response characteristics through simulations and experiments.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Identify and classify different continuous-time and discrete-time signals and systems based on their properties.
2	Perform signal operations such as scaling, shifting, reversal, sampling, and reconstruction for CT and DT signals.
3	Analyze and implement LTI systems using convolution, correlation, impulse response, and step response methods.
4	Apply Laplace Transform and Z-Transform techniques to determine system response, poles, zeros, causality, and stability.
5	Compute and interpret Fourier Series, Fourier Transform, DTFS, and DTFT for frequency-domain analysis of signals.
6	Use simulation tools/software to model signal-processing systems and evaluate practical issues such as aliasing, stability, and spectral analysis.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Generation of Various Signals and Sequences (Periodic and Aperiodic), such as Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.
2	Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power.
3	Finding the Even and Odd parts of Signal/Sequence and Real and Imaginary parts of Signal.
4	Convolution for Signals and sequences.
5	Auto Correlation and Cross Correlation for Signals and Sequences.
6	Verification of Linearity and Time Invariance Properties of a given Continuous /Discrete System.
7	Computation of Unit sample, Unit step and Sinusoidal responses of the given LTI system and verifying its physical realizability and stability properties.
8	Finding the Fourier Transform of a given signal and plotting its magnitude and phase spectrum.
9	Waveform Synthesis using Laplace Transform.
10	Locating the Zeros and Poles and plotting the Pole-Zero maps in S-plane and Z-Plane for the given transfer function.
11	Verification of Sampling Theorem.
12	Removal of noise by Autocorrelation / Cross correlation.
13	Extraction of Periodic Signal masked by noise using Correlation.

Embedded System and RTOS									
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned				
		TH	PR	Tut	TH	PR	Tut	Total	
26ECMM41	Embedded System and RTOS (Theory)	03	---	---	03	---	---	03	
26ECMML41	Embedded System and RTOS (Lab)	---	02	---	---	01	---	01	
							Total Credits	04	

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite i) Foundational understanding of C programming and Digital Logic Design. ii) Familiarity with basic microcontrollers (such as 8051 and Arduino Uno/Nano boards).	
Course Objectives:	
1	Understand fundamental concepts, characteristics, and design metrics of embedded systems.
2	Analyze embedded hardware components, communication interfaces, and ARM Cortex-M3 architecture.
3	Examine embedded software programming and foundational Real-Time Operating System (RTOS) concepts.
4	Utilize FreeRTOS features for task management, resource allocation, and synchronization.
5	Explore testing, simulation, and debugging methodologies for hardware and software.
6	Apply EDLC and hardware-software co-design principles to build practical embedded systems.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Classify and evaluate embedded systems based on applications and design metrics.
2	Analyze hardware architectures, memory types, protocols, and ARM Cortex-M3 features.
3	Develop embedded C programs and differentiate between GPOS and RTOS.
4	Implement task management, synchronization, and IPC using FreeRTOS.
5	Apply hardware and software testing, simulation, and debugging techniques.
6	Design and integrate complete embedded system solutions for real-world applications.

Module	Theory Course Contents	Hrs
1	**Introduction to Embedded Systems**	**04**
1.1	Definition, Characteristics, Classification, Applications.	
1.2	Design metrics of Embedded system.	
2	**Embedded Hardware Elements**	**08**
2.1	Features of Embedded cores- μC, ASIC, ASSP, SoC, FPGA, RISC and CISC cores. Types of memories. Communication Interfaces: Comparative study of Serial communication Interfaces -RS-232, I2C, CAN, Bluetooth (Frame formats of above protocols are not expected)	
2.2	ARM Cortex-M3 Features, Architecture, Programmer's model, Special Registers, Operating Modes and States, MPU, Memory map, Low Power modes and NVIC.	
3	**Embedded Software**	**10**
3.1	Embedded Programming in C: ALP and High-level language programming, Real-time Operating system: GPOS vs RTOS, Need of RTOS in Embedded system software. Task, Task states, Multi-tasking, Task scheduling	
3.2	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	
4	**Introduction to Free RTOS**	**05**
4.1	Free RTOS Task Management features, Resource Management features, Task Synchronization features, Event Management features, Interrupt Management features, Time Management features.	
5	**Testing and Debugging Methodology**	**03**
5.1	Testing & Debugging: Hardware testing tools, Emulator.	
5.2	Software Testing tools, Simulator, Debugger. White-Box and Black-Box testing.	
6	**System Design and Integration**	**09**
6.1	Embedded Product Design Life-Cycle (EDLC)-Waterfall Model Hardware-Software Co-design	
6.2	Design an embedded system for applications like: Precision Agriculture and Automated Irrigation, Smart Home Automation System, Automatic Chocolate Vending Machine, Washing Machine, Smart Card Reader, highlighting i) Specification requirements (choice of components), ii) Hardware architecture, iii) Software architecture	
	Total	**39**

Textbooks:	
1	Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, New Delhi, 2009.
2	SriramIyer, Pankaj Gupta," Embedded Real Time Systems Programming", Tata McGraw Hill Publishing Company ltd., 2003.
Reference Books:	
1	Rajkamal, "Embedded Systems: Architecture, Programming and Design", McGraw Hill Education (India) Private Limited, New Delhi, 2015, Edition 3rd.
2	Joseph Yiu,"The Definitive guide to ARM CORTEX-M3 & CORTEX-M4 Processors", Elsevier, 2014, 3rd Edition.
3	www.freertos.org
4	Dr. K.V. K. K. Prasad, "Embedded Real Time System: Concepts, Design and Programming", Dreamtech, New Delhi, Edition 2014.
5	Frank Vahid, Tony Givargis, "Embedded System Design – A Unified Hardware/Software Introduction", John Wiley & Sons Inc., 2002.
6	Jonathan W. Valvano, "Embedded Microcomputer Systems – Real Time Interfacing", Publisher - Cengage Learning, 3rd, edition, 2012.
7	Andrew Sloss, Domnic Symes, Chris Wright, "ARM System Developers Guide Designing and Optimising System Software", Elsevier, 2004
Access to software and virtual labs:	
1	vlabs.iitkgp.ernet.in
2	Swayam - IIT Kharagpur NPTEL 2024- Introduction to Embedded System design , nptel.ac.in.
Industry articles and case studies:	
1	nxp.com - Embedded papers
2	www.engpaper.com
3	https://ieeexplore.ieee.org
Any other (Access to AI tools / Data driven insights (if applicable) or any other):	
1	www.digi.com real life 10 examples.

Embedded System and RTOS (Lab)

Lab Prerequisite: Microprocessors & Microcontrollers, C programming.	
Lab Objectives:	
1	To interface basic input/output peripherals like LEDs, switches, and displays with embedded cores.
2	To implement actuator control mechanisms, such as speed and direction control of DC motors, using microcontrollers.
3	To develop multi-tasking applications using FreeRTOS to understand real-time scheduling.
4	To apply synchronization mechanisms like binary and counting semaphores to resolve resource conflicts.
5	To implement Inter-Process Communication (IPC) using message queues for data sharing between tasks.
6	To design, build, and troubleshoot complete real-time embedded applications integrating hardware peripherals and RTOS features.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Interface standard digital peripherals and displays with embedded hardware cores.
2	Control external hardware devices and actuators, including DC motors and buzzers, via microcontroller I/O ports.
3	Create and manage multiple tasks in real-time environments using FreeRTOS.
4	Implement task synchronization techniques to prevent race conditions and manage shared resources.
5	Utilize queue management features for safe data communication between concurrent tasks.
6	Build, test, and debug functional real-time embedded systems combining hardware interfacing and RTOS software concepts.

Sr.No.	**Suggested Experiments (**Students are required to complete at least 08 experiments)
1	Interfacing of LEDs /switches with any embedded core. (8051/ARM/STM32, etc
2	Interfacing of LCD/ Seven segment display with any embedded core. (8051/ARM/STM32, etc)
3	Interfacing of BUZZER with any embedded core.
4	Interfacing of a DC motor (speed and Direction control) with any embedded core. (8051/ARM/STM32,etc)
5	Write a Program to Create Multiple Tasks and understand the Multitasking capabilities of RTOS using (FreeRTOS).
6	Write a Program to illustrate the use of Binary and Counting Semaphore for Task Synchronization.
7	Build a Multitasking Real-Time Applications using the above IPC Mechanisms.
8	Write a Program to illustrate the Queue Management Features.

Introduction to Innovation and Entrepreneurship for Engineers									
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**				
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**	
26ECEM41	Introduction to Innovation and Entrepreneurship for Engineers (Theory)	---	---	02	---	---	---	02	
								Total Credits	**02**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
---	---	---	25	---	25

Course Objectives:	
1	Understand the fundamental concepts, types, and importance of innovation in engineering.
2	Apply design thinking methodologies, empathy mapping, and user journey analysis to engineering challenges.
3	Identify customer needs and pain points through human-centered problem-solving and brainstorming techniques.
4	Develop and validate prototypes and Minimum Viable Products (MVPs) using rapid iteration.
5	Explore entrepreneurship mindsets, business model canvases, value proposition design, and revenue structures.
6	Analyze intellectual property rights, legal frameworks, ethical standards, and social responsibility in engineering innovations.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Comprehend innovation concepts and apply design thinking principles to solve engineering problems.
2	Execute user research, empathy mapping, and user journey analysis to uncover customer pain points.
3	Generate creative ideas and translate them into actionable, human-centered problem-solving strategies.
4	Build and evaluate prototypes or MVPs based on rapid user testing and feedback loops.
5	Design viable business models and value propositions for engineering products and startup concepts.
6	Evaluate the legal, ethical, and sustainable implications of intellectual property and entrepreneurial projects.

Module	Theory Course Contents	Hrs
1	**Introduction to Innovation and Design Thinking**	**06**
1.1	Overview of innovation concepts and importance in engineering.	
1.2	Types of innovation and innovation processes.	
1.3	Introduction to design thinking methodology.	
1.4	Applying design thinking principles to engineering challenges.	
1.5	Empathy mapping and user journey analysis.	
1.6	Iterative design process and user testing.	
2	**Opportunity Identification, Ideation**	**04**
2.1	Techniques for identifying customer needs and pain points.	
2.2	Idea generation exercises and brainstorming sessions.	
2.3	Problem-solving through human-cantered design.	
3	**Prototyping and MVP Development**	**04**
3.1	Introduction to prototyping techniques and tools.	
3.2	Minimum viable product (MVP) development and validation.	
3.3	Rapid iteration and feedback gathering.	
4	**Introduction to Entrepreneurship**	**04**
4.1	Overview of entrepreneurship concepts and mindset.	
4.2	Role of entrepreneurs in driving economic and social change.	
4.3	Characteristics of successful entrepreneurs. - Case Studies	
5	**Business Model Innovation and Validation**	**04**
5.1	Introduction to business model canvas and value proposition design.	
5.2	Revenue models, pricing strategies, and cost structure analysis.	
5.3	Techniques for market research and customer validation.	
5.4	Identifying target markets and understanding customer needs.	
6	**Legal and Ethical Considerations**	**04**
6.1	Intellectual property rights and patents in engineering innovation.	
6.2	Ethical considerations in entrepreneurship and engineering practice.	
6.3	Social responsibility and sustainability in innovation and entrepreneurship.	
	Total	**26**

Textbooks:	
1	"Entrepreneurship Development and Small Business Enterprises" by Poornima M. Charantimath.
2	"Innovation and Entrepreneurship: Practice and Principles" by Peter F. Drucker.
3	"Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers" by Alexander Osterwalder and Yves Pigneur.
4	"Innovative India: Science and Technology Entrepreneurship" by K. Vijayaraghavan and Rajan Srikanth.
5	"Startup Nation: Making India a Startup Ecosystem" by Dr. H.K. Mittal.
6	"Entrepreneurship: Theory, Process, and Practice" by Kuratko, Hornsby, and Covin:
7	"Zero to One: Notes on Startups, or How to Build the Future" by Peter Thiel and Blake Masters.
Websites:	
1	Startup India (startupindia.gov.in): Provides resources, guidelines, and support for start-ups and entrepreneurs in India, including information on funding, policies, and events.
2	National Entrepreneurship Network (NEN) (wadhwanifoundation.org/national-entrepreneurship-network): Offers resources, workshops, and programs for entrepreneurship education and ecosystem development in India.
3	MIT Open Course Ware (ocw.mit.edu): Offers free online courses on entrepreneurship and innovation, including lecture notes, assignments, and case studies from MIT's entrepreneurship curriculum.
4	Stanford eCorner (ecorner.stanford.edu): Features a rich collection of videos, podcasts, and articles on entrepreneurship and innovation from Stanford University, including talks by successful entrepreneurs and industry experts.
5	Coursera (coursera.org): Provides online courses on entrepreneurship and innovation from top universities and institutions, allowing students to learn at their own pace and earn certificates.
6	TiE (The Indus Entrepreneurs) (tie.org): A global non-profit organization dedicated to fostering entrepreneurship through mentoring, networking, and education, with many chapters in India offering local support and events.
Additional Resources:	
1	Entrepreneurship Development Institute of India (EDII) (ediindia.org) Provides entrepreneurship education, training, and research programs, as well as workshops and seminars on various aspects of entrepreneurship.
2	Harvard Business Review (hbr.org) Offers articles, case studies, and insights on innovation, entrepreneurship, and business strategy from industry experts and thought leaders.

3	Khan Academy (khanacademy.org) Offers free educational resources, including lessons on entrepreneurship, economics, and business fundamentals.

Term-Work: The Assessment will be based on a set of 5 activities of 5 marks each.
The suggested list of activities:

1	Individual and group assignments (e.g., business model canvas, market research report).
2	Presentations and pitches for venture ideas.
3	Participation in discussions and workshops.
4	Reflection papers or journals documenting personal learning and growth.
5	Presentation of innovation projects by students.
6	Feedback and peer evaluation of prototypes.
7	Reflection on the innovation process and lessons learned.

Full Stack Development								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECVSEL41	Full Stack Development (Lab)	---	04	---	---	02	---	02
							Total Credits	**02**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
---	---	---	25	25	50

Lab Objectives:	
1	To install and configure local web servers and databases using XAMPP for web development.
2	To design structured web pages using HTML5 elements, hyperlinks, and CSS3 styling.
3	To implement interactive web forms with client-side validation using JavaScript.
4	To develop responsive web layouts and interfaces utilizing Bootstrap frameworks.
5	To write server-side scripts using PHP to handle logic, control structures, sessions, and data processing.
6	To integrate frontend components with MySQL databases and dynamic visualization tools like ChartJS.

Lab Outcomes:
After successful completion of the modules, students will be able to:

1	Set up and manage a local development environment with Apache and MySQL.
2	Build well-structured, styled, and linked web pages using HTML5 and CSS3.
3	Create interactive forms and validate user inputs effectively using JavaScript.
4	Design responsive and modern user interfaces utilizing CSS frameworks like Bootstrap.
5	Develop dynamic server-side applications using PHP logic, arrays, functions, and sessions.
6	Connect web applications to MySQL databases and build real-time data-driven applications.

Suggested Experiments:

Sr.No.	Name of the Experiments
1	To install, configure and test XAMPP (Apache and MySQL)
2	Design a web page using HTML5, containing images with relative link and absolute link.
3	Design web pages using HTML5 and CSS3 on selected problem statements. Design at least two pages linked with each other and containing links to other websites on the Internet.
4	Design a form, with different form fields e.g. text fields, password fields, checkboxes, radio buttons, sliders. Write Java Script for client side validation.
5	Design a web page using Bootstrap
6	Design web pages using php to demonstrate, control statements, loops, arrays, functions, and sessions.
7	Design Web pages using php with database connectivity to MySQL
8	To develop a real-time auto-updating graph using ChartJS, JSON, JavaScript, MySQL and PHP.

Field Projects								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECFP41	Field Projects	---	04	---	---	02	---	02
							Total Credits	**02**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
---	---	---	25	25	50

Project Objectives:	
1	To expose students to real-world industrial environments, rural setups, or civic infrastructure to observe operational workflows and identify engineering challenges.
2	To train students in conducting professional stakeholder interviews, field surveys, and technical data collection while adhering to site safety protocols.
3	To enable students to synthesize core electronics and computer science concepts—such as embedded hardware, IoT, networking, and software frameworks—to design viable solutions.
4	To develop foundational skills in project management, including cost-benefit budgeting, component sourcing, and clear distribution of responsibilities within a team.
5	To foster professional communication, technical documentation, and presentation skills through the compilation of a formal engineering field report.
Project Outcomes: After successful completion of the modules, students will be able to:	
1	Identify real-world socio-economic or industrial problems by interacting with local stakeholders and industries.
2	Analyze existing hardware-software engineering frameworks to formulate an optimized technical solution.
3	Apply Electronics and Computer Science concepts (IoT, embedded systems, networking, web/app design) to solve the identified problem.
4	Demonstrate ethical practices, teamwork, and financial budgeting (cost-benefit analysis) during field execution.
5	Document field findings systematically in a standard technical report and present the solution effectively.

Field Projects

Stage No.	Stages of Field Project
1	**Project Planning and Proposal Development**
	Defining project objectives and scope, conducting literature review and background research, developing project proposal and timeline, Identifying required resources and constraints.
2	**Design and Implementation**
	Selecting appropriate methodologies and Simulation tools, designing system architecture and components, Prototyping and testing system functionalities, iterative development and troubleshooting.
3	**Documentation and Reporting**
	Maintaining detailed project documentation, recording progress, challenges and solutions, writing technical reports and documentation, Creating presentations for project updates and final presentation.
4	**Project Presentation and Evaluation**
	Delivering oral presentations of project progress, demonstrating project outcomes and achievements, responding to questions and feedback from peers and instructors, reflecting on lessons learned and areas for improvement.

Guidelines to maintain quality of field project are as follows:
Students can achieve this by making proper selection of projects based on field visit/ study of archives from the library. Encourage the use of open-source software's for simulation, design and documentation of the projects.

Project Topic selection and approval:

1. The group may be of maximum FOUR (04) students.
2. The students are required to visit industry/community/library to identify the problem statement and be able to provide the proof of interaction.
3. Topic selection and approval by panel of experts from the department.
4. Log Book to be maintained by each group to record the weekly progress.
5. Suggested steps for project selection and implementation.
   a. Identify Project Goals and Objectives
   b. Conduct Needs Assessment: (Identify potential stakeholders, such as industries, communities, or organizations, and assess their needs or challenges that could be addressed through the project.)
   c. Research and Explore Options
   d. Formulate Problem Statements
   e. Evaluate Feasibility
   f. Select Project Scope
   g. Develop Project Plan
   h. Prototype Development (for Hardware Projects) Software Development (for Software Projects)
   i. Testing and Validation
   j. Monitoring and Evaluation
   k. Documentation and Reporting

Assessment Criteria for Field Projects

- **Field Execution & Data Quali**ty: Accuracy of data collected during minimum 2-3 field visits or industry interactions.
- **Report Documentation**: Structural compliance (Introduction, Literature Review, Methodology, Analysis, and Conclusion) spanning 20–40 structured pages.
- **Presentation & Viva**: Communication clarity, teamwork integrity, and higher-order critical thinking under direct questioning.

Evaluation Structure and Marks Distribution

- **Term Work** (**25 Marks**):
  Practical/Field execution & active participation: 15 Marks
  Mini-project, case study, or assignments: 5 Marks
  Regular attendance and journal/report documentation: 5 Marks
- **Practical/Oral Examination** (**25 Marks**):
  Demonstration of field/lab experiment or code/model: 15 Marks
  Viva voce / Oral defense of methodology and findings: 10 Marks

Project Report Structure & Guidelines:

Front Matter

- Title Page: Project title, student names, roll numbers, department, college name, and submission date.
- Certificate: Signed approval from the project guide and the head of the department.
- Acknowledgments: Thanks to the guide, peers, and institution for their support.
- Abstract: A brief 200-word summary of the problem, method, and key results.
- Table of Contents: List of chapters, sections, and page numbers.
- List of Figures and Tables: Index of all diagrams, graphs, and data tables.

Main Body

- **Introduction:**
  a) Background of the field work or problem.
  b) Objectives and scope of the project.
  c) Significance of the study.
- **Literature Survey:**
  a) Review of existing papers, systems, or standards.
  b) Identification of gaps the project aims to solve.
  c) Methodology / System Design:
  d) Block diagrams, flowcharts, or architectural layouts.
  e) Tools, software, or hardware components used.
  f) Data collection methods or field study procedures.
- **Implementation / Execution:**
  a) Step-by-step details of the work done in the field or lab.
  b) Code snippets, circuit designs, or process workflows.
- **Results and Discussion:**
  a) Data analysis, test results, or performance graphs.
  b) Comparison with expected outcomes or standard values.
  c) Conclusion and Future Scope:
  d) Summary of findings.
  e) Limitations of the current work and ideas for future improvement.

End Matter

a) References: Citations of books, journals, and websites in IEEE or APA format.
b) Appendices: Large data sheets, raw survey forms, or extra code.

Open Electives (NPTEL Courses)									
Course Code	**Course Name**	**Teaching Scheme** Course Duration			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECOE4X	Online Open Elective (Theory)	12 weeks	---	---	04	---	---	04
								Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
---	Online NPTEL assignments*	100*	---	---	100*

(**marks will be allotted based on the consolidated score awarded by NPTEL*)

Mode of Learning: Online (NPTEL / SWAYAM Platform)
Nature of Course: Self-learning (MOOC)
Assessment: NPTEL Certification There will be no Internal Assessment (CA) and no End Semester Examination (ESE) conducted by the Institute. Credits awarded based on NPTEL certificate.
List of Courses: (will be announced as per the schedule of NPTEL, which is announced before the commencement of the respective semesters)
Important Note: The syllabus would be as prescribed by NPTEL for the selected list of courses by the Department.

Textbooks / Learning Resources :
1. Video lectures 2. Weekly assignments 3. Reference material uploaded by the course instructor

Rules for Open Elective (OE) – Semesters 4 and 5

1. **Course Registration & Certificate Submission**
Students must register and submit the passing certificate of an NPTEL course chosen from the department-suggested list.

2. **Mode of Learning**
The NPTEL course must be completed independently by the student (self-learning mode).

3. **Assignments & Examination**
Students must timely submit all NPTEL assignments and appear for the NPTEL proctored exam.

4. **Credit Awarding**
After successfully passing the NPTEL course, 4 credits will be awarded on production of certificate from NPTEL.

5. **Fees**
NPTEL courses are free for enrollment, but the exam fees must be borne by the student.

6. **SWAYAM Local Chapter Registration**
During NPTEL registration, students must:
   - Select YES for "Are you part of a SWAYAM Local Chapter?"
   - Choose the college name from the list. (College Code: 2173)

7. **ABC Account & APAAR ID**
Students must mention their ABC Account Number and APAAR ID in their Profile detail.

8. **Fail / Absent in NPTEL Exam**
   - Students who fail or remain absent must reappear in the next NPTEL re-exam (generally conducted after 6 months).
   - If the course is not re-run in the next cycle, the student must choose another course from the department-approved NPTEL list.

9. **Result & Mark sheet**
   - The grading system for Open Elective subjects will remain the same as other subjects.
   - If the student fails to pass the subject in the respective semester, against the Open Elective subject No Certificate (NC) would be indicated in the mark sheet, they would loose the grade points of the subject.

- Credits will be awarded as and when the student submits the certification from NPTEL.
- The students who are not able to produce NPTEL certification till the end of 8th semester are bound to clear OE offered by the Institute in the next academic year whose exams will be conducted offline.
- Student shall be permitted to appear for the offline Open Elective examination conducted by the Institute only if they have attempted the corresponding NPTEL examinations at least twice and were unable to pass.

Department of Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-V
A.Y. 2026-27

Department of Electronics and Computer Science

Semester V Teaching Scheme										
Course Type	Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned				
			TH	PR	TUT	TH	PR	TUT	TOTAL	
PCC	26ECPC51/ 26ECPCL51	Digital VLSI	3	2	---	3	1	---	4	
PCC	26ECPC52	Digital Signal Processing	3	---	1*	3	---	---	3	
PCC	26ECPC53/ 26ECPCL53	Software Engineering	2	2	---	2	1	---	3	
PEC	26ECPE15X/ 26ECPE1L5X	Program Elective 1	3	2	---	3	1	---	4	
MDM	26ECMM51/ 26ECMML51	Internet of Things	3	2	---	3	1	---	4	
OE	26ECOE5X	Open Elective (NPTEL MOOC Course)	##	---	---	---	---	---	4	
	Total Credits								22	

*Non Credit

	Semester V Marks Scheme							
Course Type	Course Code	Course Name	TH	MT	CA	TW	PR/ OR	Total
PCC	26ECPC51/ 26ECPCL51	Digital VLSI	60	20	20	25	25	150
PCC	26ECPC52	Digital Signal Processing	60	20	20	25	---	125
PCC	26ECPC53/ 26ECPCL53	Software Engineering	60	20	20	25	25	150
PEC	26ECPE15X/ 26ECPE1L5X	Program Elective 1	60	20	20	25	25	150
MDM	26ECMM51/ 26ECMML51	Internet of Things	60	20	20	25	25	150
OE	26ECOE5X	Open Elective (NPTEL MOOC Course)##	100	---	---	---	---	100
	Total Marks							825

- Students are required to complete a 12 weeks MOOC course from the suggested list recommended by the department.

Program Electives (PEC 1)	Open Electives (OE) (for A.Y. 2026-27)
26ECPE151: Statistics for Engineers	**26ECOE51:** German - II
26ECPE152: Design and Analysis of Algorithms	**26ECOE52:** Soft Skills
26ECPE153: Communication System	**26ECOE53:** Public Speaking
	26ECOE54: Business to Business Marketing (B2B)
	26ECOE55: Privacy and Security in Online Social Media
	26ECOE56: German - I
	26ECOE57: E-Business

Digital VLSI

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC51	**Digital VLSI (Theory)**	**03**	**---**	**---**	**03**	**---**	**---**	**03**
26ECPCL51	**Digital VLSI (Lab)**	**---**	**02**	**---**	**---**	**01**	**---**	**01**
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Digital System Design,
Electronic Devices and Circuits

Course Objectives:

1	To understand VLSI Design flow and technology trends.
2	To realise MOS based circuits using different design styles.
3	To explore static and dynamic CMOS logic styles.
4	To design and implement complex Boolean functions and sequential circuits.
5	To study and analyze different memory circuits.
6	To understand and design high-performance arithmetic units.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Explain VLSI design methodologies and semiconductor fabrication processes.
2	Analyze the static and dynamic behavior of NMOS and CMOS inverters.
3	Design CMOS logic gates using various design styles.
4	Realize combinational and sequential logic functions.
5	Demonstrate understanding of memory architectures and their working principles
6	Design and evaluate high-speed arithmetic circuits.

Module	Theory Course Contents	Hrs
1	**VLSI Design flow and Technology Trends**	**05**
1.1	VLSI Design Flow: Full custom and Semicustom IC design flow.	
1.2	Semiconductor Manufacturing: Semiconductor technology trend, clean rooms, Fabrication flowchart for steps in IC fabrication.	
1.3	Scaling: Types of scaling, comparison of MOSFET Model levels.	
1.4	Technology Comparison: Comparison of BJT and MOS technologies, long channel and short channel MOS devices.	
2	**MOSFET Inverters**	**08**
2.1	Introduction to MOS inverters: Active and passive load nMOS inverters, CMOS inverter and their comparison.	
2.2	Circuit Analysis of MOS Inverters Static Analysis of Resistive nMOS and CMOS Inverters: Calculation of critical voltages and noise margins.	
2.3	Design of symmetric CMOS inverter.	
2.4	Analysis of CMOS inverter: Calculation of rise time, fall time and propagation delay.	
3	**MOS Circuit Design Styles**	**07**
3.1	Static CMOS.	
3.2	Pseudo NMOS design styles.	
3.3	Pass transistor, Transmission gate.	
3.4	Dynamic: C^2MOS.	
3.5	Layout of CMOS Inverter, CMOS NAND, CMOS NOR.	
4	**Combinational and Sequential Circuit Realization**	**07**
4.1	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.	
4.2	SR Latch, JK FF, D FF using CMOS logic.	
5	**Semiconductor Memories**	**05**
5.1	SRAM: 6T SRAM operation, design strategy, read/write circuits, sense amplifier.	
5.2	DRAM: 1TDRAM, operation modes, leakage currents, refresh operation, physical design.	

6	**Data Path Design**	**07**
6.1	Adder: CLA adder, MODL, Manchester carry chain, High-speed adders: carry skip, carry select and carry save.	
6.2	Multipliers and shifter: Array multiplier and barrel shifter.	
	Total	**39**

Textbooks:	
1	CMOS Digital Integrated Circuits Analysis and Design, Sung-Mo Kang and Yusuf Leblebici, Tata McGraw Hill, Revised 4thEdition.
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 ChandrakasanBorivoje 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 Sutherlan 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

DIGITAL VLSI (LAB)

Lab Objectives:	
1	To understand and analyze the transfer and output characteristics.
2	To design and simulate CMOS inverters and logic gates.
3	To perform comparative analysis of NMOS inverters.
4	To implement combinational and sequential digital circuits.
5	To explore SRAM cell operation and stability.
6	To develop and simulate CMOS layouts.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Plot and interpret the transfer and output characteristics of NMOS and PMOS devices.
2	Design and simulate CMOS inverters and evaluate parameters.
3	Implement and analyze complex logic functions.
4	Model and simulate arithmetic circuits.
5	Design and analyze 6T SRAM cell operation.
6	Create, simulate, and extract CMOS layouts.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	**Name of the Experiments**
1	Plot Transfer and output characteristics of NMOS and PMOS
2	Design CMOS inverter. Carry out static as well as transient simulation with different aspect ratio of pull up and pull-down devices
3	Comparative analysis of the NMOS Inverter with different types of loads.
4	Find the equivalent CMOS inverter for the given 2-input NAND and NOR gates
5	Implement the given equation using various logic design style
6	Implementation of any Flip- Flop using various logic design styles
7	Simulate Minimum Sized CMOS INVERTER circuit to calculate τPHL and τPLH
8	Design and Simulate 4:1 multiplexer using NMOS pass transistor
9	Design and simulate 4-bit adder/subtractor
10	Design CMOS transmission gate and perform all the analysis to verify its Characteristics.
11	Design and Simulate 4-bit multiplier
12	Simulate and carry out comparative analysis for 6T SRAM cell with a) β= 1.5 and α=1, and b) β= 1 and α=1
13	Draw the CMOS schematic and Layout of the inverter circuit, simulate layout
14	Extraction of CMOS layout and simulation of the extracted Inverter
15	Draw and simulate layout for CMOS NAND and CMOS NOR gate

Digital Signal Processing

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC 52	Digital Signal Processing (Theory)	03	---	01	03	---	---	03
							Total Credits	**03**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	---	---	**100**

Course Objectives:	
1	Understand discrete-time signals, systems, and time-domain operations.
2	Analyze LTI systems using DTFT and Z-transforms.
3	Compute DFT and apply efficient Radix-2 FFT algorithms.
4	Design IIR digital filters using analog filter mapping techniques.
5	Design FIR digital filters utilizing standard window methods.
6	Study DSP processor architectures and real-world signal processing applications.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Analyze discrete-time signals and systems using time-domain operations.
2	Evaluate LTI system stability and frequency response via Z-transforms and DTFT.
3	Calculate DFT and implement fast transform algorithms.
4	Design IIR filters using impulse invariance and bilinear transformations.
5	Design linear-phase FIR filters using window functions.
6	Examine DSP hardware architectures and application workflows.

Module	Theory Course Contents	Hrs
1	**Discrete-Time Signal and Discrete-Time Systems**	**05**
1.1	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.	
1.2	Classification of Discrete-Time Signals, Classification of Discrete-Systems, LTI system, Impulse Response, Step Response, linear convolution, Correlation.	
2	**Frequency Domain Analysis using DTFT and Z Transform**	**07**
2.1	Introduction to DTFT.	
2.2	Z transform - definition transform of standard signals, ROC, poles and zeros of transfer function, Inverse Z transform.	
2.3	Analysis and characterization of LTI system using Z transform, impulse and step response, causality, stability, stability of causal system.	
3	**Discrete Fourier Transform and Fast Fourier Transform**	**07**
3.1	Introduction to DFT and IDFT.	
3.2	Properties of DFT, circular convolution of sequences using DFT	
3.3	Fast Fourier transforms (FFT), Radix-2 decimation in time and decimation in frequency FFT algorithms, inverse FFT.	
4	**IIR Digital Filters**	**07**
4.1	Comparison of IIR and FIR filters, Types of IIR Filters.	
4.2	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.	
5	**FIR Digital Filters**	**07**
5.1	Characteristics of FIR digital filters, Linear Phase Filter.	
5.2	Design of FIR filters using window techniques -Rectangular, Hamming, Blackman, Software simulation – Design of FIR Filters.	
6	**DSP Processors and Applications**	**06**
6.1	General purpose digital signal processors, DSP processor architecture, Selecting digital signal processors, Special purpose DSP hardware.	
6.2	Applications of DSP: Radar Signal Processing and Speech Processing.	
	Total	**39**

Textbooks:	
1	Emmanuel C. Ifeachor, 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.
Reference books:	
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 Education.
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.

Software Engineering									
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned				
		TH	PR	Tut	TH	PR	Tut	Total	
26ECPC 53	Software Engineering (Theory)	02	---	---	02	---	---	02	
26ECPCL 53	Software Engineering (Lab)	---	02	---	---	01	---	01	
							Total Credits	03	

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Fundamentals of Programming, Data Structures	
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, analyse 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 concept of software quality assurance and Risk Management.
6	To learn different software testing strategies and tactics.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Apply software engineering concept and choose process models for a software project development.
2	Analyse 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 software system.
5	Identify risks and prepare RMMM plan for quality software system.
6	Apply testing strategies and tactics for software system.

Module	Theory Course Contents	Hrs
1	**Introduction to Software Engineering and Process Models**	**06**
1.1	Nature of Software, Software Process framework.	
1.2	Prescriptive Models: Waterfall Model, Incremental, RAD Models Evolutionary Process Models Prototyping, Spiral and Concurrent Development Model. Specialized Models: Component based. Introduction to Agile methodology.	
2	**Requirement Engineering and Modelling**	**02**
2.1	Feasibility Study Types of Requirements, Requirement Engineering Task, Software Requirement Specification (SRS).	
3	**Design Engineering**	**06**
3.1	Developing Use Cases (UML) ,Requirement Model: Scenario-based model, Class-based model, Behavioural model.	
3.2	User Interface Design- **Introduction to User Interface (UI) Design:**Definition, purpose, and importance in software systems,Key differences between UI and UX,Real-world examples of good and bad UI. **Principles of Good UI Design:** Core design principles: consistency, simplicity, feedback, visibility.	
4	**Project scheduling & Cost Estimation**	**05**
4.1	Project Scheduling, defining a Task Set for the Software Project, Ganttcharts, Program Evaluation Review Techniques (PERT), Tracking the Schedule	
4.2	Software Project Estimation, Decomposition Techniques, LOC based, FP based , COCOMO I Model and COCOMO II Model.	
5	**Software Risk & Quality Management**	**04**
5.1	Software Risk, Types of Risk, Risk Identification, Risk Assessment, Risk Projection, RMMM.	
5.2	Software Quality Assurance Task and Plan, McCall's Quality Factors, Software Reliability, Formal Technical Review (FTR).	
6	**Software Testing Strategies and Tactics**	**03**
6.1	Software Testing Fundamentals, Testing strategies for conventional and Object-Oriented architectures, Unit testing, Integration testing, System Testing, Validation and System Testing.	
6.2	Testing Tactics: White-Box Testing, Basis Path Testing, Control Structure Testing, Black-Box Testing.	
	Total	**26**

Textbooks:	
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
Reference books:	
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

Software Engineering (Lab)

Lab Objectives:	
1	To guide students in conducting feasibility analyses and selecting suitable software process models with proper justifications.
2	To train students in writing detailed Software Requirement Specification (SRS) documents and designing standard UML diagrams for software modeling.
3	To equip students with project scheduling and management techniques to create project timelines and track progress effectively using modern tools.
4	To teach students how to identify, analyze, and manage software risks using a structured Risk Mitigation, Monitoring, and Management (RMMM) framework.
5	To enable students to accurately estimate software size, cost, and effort utilizing Lines of Code (LOC), Function Points (FP), use-case techniques, and the COCOMO II model.
6	To provide hands-on experience in designing and executing white-box and black-box test cases, as well as conducting comprehensive system-level testing.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Demonstrate the ability to perform feasibility analysis and select an appropriate software process model with justification.
2	Develop comprehensive Software Requirement Specification (SRS) documents and effectively model software using UML diagrams.
3	Apply project scheduling and management techniques using tools to create timelines and monitor progress.
4	Identify, analyze, and plan for software risks through a structured Risk Mitigation, Monitoring, and Management (RMMM) approach.
5	Estimate software size, cost, and effort using LOC, FP, use-case techniques, and the COCOMO II model.
6	Design and execute test cases using white-box and black-box testing methods, and conduct system-level testing.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Prepare detailed statement of problem with feasibility study and identify suitable process model for the same with justification.
2	Develop Software Requirement Specification (SRS) document in IEEE format for the project.
3	Prepare schedule for the project using any project management tool
4	Prepare RMMM plan for the project.
5	Identify scenarios & develop UML Use case and Class Diagram for the project.
6	Develop Activity / State Transition diagram and Sequence diagram for the project.
7	Develop test cases for the project using white box testing.
8	Estimate project size using LOC, FP, and Use-Case based techniques
9	Apply the COCOMO II model for cost and effort estimation.
10	Write and review a Software Quality Assurance (SQA) plan.
11	Conduct Integration and System Testing on a modular application.

Statistics For Engineers								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECPE151	**Statistics for Engineers (Theory)**	**03**	**---**	**---**	**03**	**---**	**---**	**03**
26ECPE1L 51	**Statistics for Engineers (Lab)**	**---**	**02**	**---**	**---**	**01**	**---**	**01**
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	**20**	**60**	**25**	**25**	**150**

Course Prerequisite: Fundamentals of Engineering Mathematics-1, Fundamentals of Engineering Mathematics-2.	
Course Objectives:	
1	Introduce fundamental data categorization, descriptive statistics, and visualization techniques.
2	Provide a foundation in probability rules, Bayes' theorem, and standard distributions.
3	Explain various sampling methodologies and the process of interval estimation.
4	Develop skills to formulate and conduct hypothesis testing for varied sample sizes.
5	Teach simple and multiple linear regression models for estimation and prediction.
6	Introduce decision-making criteria under uncertainty using decision tables and trees.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Summarize and visualize categorical and quantitative data using descriptive statistics.
2	Apply probability rules and continuous/discrete distributions to model scenarios.
3	Select appropriate sampling methods and compute confidence intervals for population parameters.
4	Perform hypothesis testing using t-tests and z-tests for statistical validation.
5	Build and evaluate linear and multiple regression models for predictive analysis.
6	Evaluate complex decisions under uncertainty using established criteria and decision trees.

Module	Theory Course Contents	Hrs
1	**Introduction**	**05**
1.1	**Data and Statistics**: Elements, Variables, and Observations, Scales of Measurement, Categorical and Quantitative Data, Descriptive Statistics: Tabular and Graphical Summarizing Categorical Data, Summarizing Quantitative Data, Cross Tabulations and Scatter Diagram.	
1.2	**Descriptive Statistics:** Measures of dispersion, central tendency, Detecting Outliers, Box Plot.	
2	**Probability**	**06**
2.1	**Probability :** Experiments, Counting Rules, and Assigning Probabilities, Events and Their Probabilities, Complement of an Event, Addition Law Independent Events, Multiplication Law, Bayes' theorem, Central limit Theorem.	
2.2	**Discrete Probability Distributions** Random Variables, Discrete Probability Distributions, Expected Value and Variance, Binomial Probability Distribution and Poisson Probability Distribution without proof.	
2.3	**Continuous Probability Distributions:** Uniform Probability Distribution, Normal Curve, Standard Normal Probability Distribution without proof, Computing Probabilities for Any Normal Probability Distribution.	
3	**Sampling and Sampling Distributions**	**05**
3.1	Sampling Methods, Simple random sampling with and without replacement, Stratified Random Sampling, Cluster Sampling, Systematic Sampling, Convenience Sampling, and Judgment Sampling.	
3.2	Interval Estimation: Population Mean: Known, Population Mean: Unknown, Determining the Sample Size, Population Proportion.	
4	**Hypothesis Tests**	**10**
4.1	Developing Null and Alternative Hypotheses, Type I and Type II Errors, One tailed and two tailed test.	
4.2	Small samples test (student's t - distributions), Large samples test (z - test).	
5	**Regression**	**08**
5.1	**Simple Linear Regression:** Simple Linear Regression Model, Regression Model and Regression Equation, Estimated Regression Equation, Least Squares Method, Coefficient of Determination, Correlation Coefficient, Model Assumptions, testing for Significance, Using the Estimated Regression Equation for Estimation and Prediction Residual Analysis: Validating Model Assumptions.	
5.2	**Multiple Regression:** Multiple Regression Model, Least Squares Method, Partial correlation coefficients and Partial regression coefficients.	

6	**Decision Theory**	**05**
6.1	Decision making in case of unknown probability of events: Maximin Criterion, Minimax Criterion, Maximax Criterion, Minimin Criterion, Laplace Criterion, Savage method, Hurwitz criterion. Decision Table, Decision trees.	
Total		**39**

Textbooks:	
1	https://static1.squarespace.com/static/5ff2adbe3fe4fe33db902812/t/6009dd9fa7bc363aa822d2c7/ 1611259312432/ISLR+Seventh+Printing.pdf
2	Data Science from Scratch, FIRST PRINCIPLES WITH PYTHON, O'Reilly, Joel Grus,
3	Data Science from Scratch (oreillystatic.com)
4	Practical Time Series Analysis, Prediction with statistics and Machine Learning, O'Reilly, Aileen Nielsen [Download] O'Reilly Practical Time Series Analysis PDF (lunaticai.com)
5	R for data science: Import, Tidy, Transform, Visualize, And Model Data, O'Reilly , Garrett Grolemund, Hadley Wickham
6	Python for Data Analysis, 2nd Edition, O'Reilly Media, Wes McKinney.
7	https://static1.squarespace.com/static/5ff2adbe3fe4fe33db902812/t/6009dd9fa7bc363aa822d2c7/ 1611259312432/ISLR+Seventh+Printing.pdf
Reference books:	
1	Data Science for Dummies Paperback, Wiley Publications, Lillian Pierson
2	Storytelling with Data: A Data Visualization, Guide for Business Professionals, Wiley Publications, Cole Nussbaumer Knaflic
3	Probability and Statistics for Engineering and the Sciences, Cengage Publications Jay L. Devore.

Statistics for Engineers (Lab)

Lab Objectives:	
1	To train students in creating various data visualizations to effectively explore and interpret data.
2	To guide students in analyzing real-world problems and solving them using the principles of probability distributions.
3	To equip students with techniques to examine large data sets and extract meaningful insights through sampling and its distributions.
4	To enable students to fit regression models to data and utilize them for accurate predictive analysis.
5	To provide practical experience in developing and testing hypotheses regarding population parameters to draw valid statistical conclusions.
6	To foster skills in building decision trees to derive logical inferences and support effective decision-making processes.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Develop various visualizations of the data in hand.
2	Analyze a real-world problem and solve it with the knowledge gained from probability distributions.
3	Analyze large data sets and perform data analysis to extract meaningful insights from the sampling and its distributions.
4	Fit a regression model to data and use it for prediction.
5	Develop and test a hypothesis about the population parameters to draw meaningful conclusions.
6	Develop inference on decision making using decision trees.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Introduction to Python/MATLAB for Statistical Computing
2	Implementation of Importing and Cleaning Data using Python/MATLAB
3	Generate and interpret basic plots like histograms, Bar Charts and box plots.
4	Calculate mean, median, mode, variance, and standard deviation.
5	Detection of Outliers using box plots and Z-Score
6	Simulate and visualize probability distributions: Binomial and Poisson distribution
7	Simulate, calculate probabilities and visualize the normal distribution curve.
8	Simulate the Central Limit Theorem through sampling.
9	Apply various sampling methods i.e Simple, Stratified, Systematic on datasets
10	Construct confidence intervals from sample data and estimate population parameters with specified confidence..
11	Perform hypothesis testing (z-test, t-test) for single samples
12	Compute and compare two population means using t-tests
13	Perform Chi-Square Test for Independence.
14	Perform Linear Regression Analysis and fit and evaluate simple regression models.
15	Analyze datasets with multiple predictors using Multiple Linear Regression
16	Evaluate the fitness of regression models using residual analysis method
17	Compute and interpret Pearson and Spearman correlation coefficients.
18	Solve decision problems using Maximin, Minimax, Laplace, and Savage criteria.
19	Evaluate decision trees for classification problems.
20	Mini Project: Real-World Data Analysis (Healthcare, Finance, etc.)

Design and Analysis of Algorithms

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE1 52	Design and Analysis of Algorithms (Theory)	03	---	---	03	---	---	03
26ECPE1L52	Design and Analysis of Algorithms (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Data structures, Discrete structures and Automata Theory.

Course Objectives:

1	Introduce fundamental algorithm design techniques, asymptotic analysis, recurrence relations, and complexity classes (P, NP).
2	Explain the divide-and-conquer paradigm and its application to sorting, searching, and matrix multiplication problems.
3	Teach the greedy method approach for solving optimization problems like shortest paths, scheduling, and spanning trees.
4	Explore dynamic programming techniques to solve complex optimization problems through overlapping subproblems.
5	Demonstrate backtracking and branch-and-bound strategies for combinatorial search and optimization.
6	Examine advanced string-matching algorithms for efficient pattern searching in text data.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Analyze time and space complexity of algorithms using asymptotic notations and solve recurrences.
2	Apply the divide-and-conquer approach to design and analyze efficient sorting, searching, and computational algorithms.
3	Develop greedy algorithms to solve optimization problems such as minimal spanning trees and shortest paths.
4	Implement dynamic programming solutions for multi-stage graphs, knapsack, and shortest path problems.
5	Solve combinatorial search problems using backtracking and branch-and-bound techniques.
6	Utilize string-matching algorithms like KMP and Rabin-Karp for efficient pattern detection.

Module	Theory Course Contents	Hrs
1	**Introduction**	**08**
1.1	Brief introduction of Algorithms and its design methods. Analysis of Algorithm - Time & Space Complexity. Growth of Functions: Asymptotic Notation (O, Ω, θ, w, o), Standard Notation and Common Functions. Complexity class: Definition of P, NP, NP-Hard, NP-Complete Analysis of selection sort, insertion sort.	
1.2	Recurrences: The substitution method, Recursion tree method, Master method	
2	**Divide and Conquer Approach**	**06**
2.1	General Method, Analysis of Merge Sort, Analysis of Quick sort, Analysis of Binary search.	
2.2	Strassen's Matrix Multiplication.	
3	**Greedy Method Approach**	**07**
3.1	General Method, Single source shortest path-Dijkstra's algorithm, Job sequencing with deadlines, Fractional Knapsack problem,	
3.2	Minimum cost spanning trees-Kruskal and Prim's algorithm.	
4	**Dynamic Programming Approach**	**08**
4.1	General Method, Multistage graphs, Single source shortest path: Bellman Ford Algorithm, All pair shortest path problem: Floyd Warshall Algorithm.	
4.2	Assembly-line scheduling Problem, 0/1 knapsack Problem, Travelling Salesperson problem, longest common subsequence.	
5	**Backtracking and Branch and bound**	**06**
5.1	Backtracking: General method, N queen problem, Sum of subsets, Graph coloring.	
5.2	Branch and Bound: Travelling salesman problem, 15 puzzle problem.	
6	**String Matching algorithms**	**04**
6.1	The Naïve string-matching algorithm, The Rabin Karp algorithm, The Knuth-Morris-Pratt algorithm	
Total		**39**

Textbooks:	
1	T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2	Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press 2010.
Reference books:	
1	Parag Himanshu Dave, Himanshu Bhalchandra Dave, Design and Analysis Algorithms - Publisher: Pearson
2	Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGrawHill Edition.
3	S. K. Basu, "Design Methods and Analysis of Algorithm", PHI
Access to NPTEL / Swayam Course:	
1	https://nptel.ac.in/courses/106/106/106106131/
2	https://swayam.gov.in/nd1_noc19_cs47/preview
3	https://www.coursera.org/specializations/algorithms
4	https://www.mooc-list.com/tags/algorithms

Design and Analysis of Algorithms (Lab)

Lab Prerequisite: Knowledge of one or more programming language e.g. Python, C++. and proficiency in any one of them.	
Lab Objectives:	
1	To train students in evaluating and analyzing the time and space complexity of various algorithms.
2	To guide students in describing, applying, and analyzing the complexity of algorithms based on the divide-and-conquer strategy.
3	To enable students to design, implement, and assess the complexity of solutions using the greedy strategy.
4	To equip students with the ability to formulate and analyze dynamic programming solutions and their associated complexities.
5	To provide hands-on experience in explaining and implementing advanced problem-solving techniques such as backtracking, branch, and bound.
6	To foster skills in understanding and executing string matching algorithms for text processing applications.

Lab Outcomes: After successful completion of the lab course students 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 strategy.
3	Describe, apply and analyze the complexity of greedy strategy.
4	Describe, apply and analyze the complexity of dynamic programming strategy.
5	Explain and apply backtracking, branch and bound.
6	Explain and apply string matching techniques.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Experiment on comparative analysis of Selection Sort and Insertion Sort.
2	Experiment on comparative analysis of Quick Sort and Merge Sort.
3	Experiment on Fractional Knapsack Problem.
4	Experiment on Prim's and Kruskal's Algorithm for finding Minimum Cost Spanning Tree.
5	Experiment on Single source shortest path-Dijkstra's algorithm.
6	Experiment on Single source shortest path: Bellman Ford Algorithm
7	Experiment on Traveling Salesperson Problem using Dynamic Programming.
8	Experiment on longest common subsequence.
9	Experiment using Backtracking strategy.
10	Experiment using branch and bound strategy.
11	Experiment on string matching algorithms.

Communication Systems

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE153	Communication Systems (Theory)	03	---	---	03	---	---	03
26ECPE1L53	Communication Systems (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Digital System Design, Electronics Devices and Circuits.

Course Objectives:

1	Introduce fundamental concepts of electronic communication systems, spectrum allocations, and noise performance metrics.
2	Explain the principles, generation, and spectral analysis of various analog modulation schemes (AM, FM, PM).
3	Examine the operation and characteristics of radio transmitters and superheterodyne receivers.
4	Teach pulse modulation techniques, sampling theorems, quantization, and multiplexing methods (TDM, FDM).
5	Explore pulse shaping concepts, line codes, intersymbol interference (ISI), and equalization strategies.
6	Analyze digital modulation techniques, signal space representations, and spectral efficiencies.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Understand the core blocks of communication systems and evaluate system performance using noise metrics.
2	Analyze time-domain and frequency-domain characteristics of analog modulation and angle modulation techniques.
3	Describe the architecture and working principles of radio transmitters and superheterodyne receivers.
4	Apply sampling, quantization, and coding techniques for pulse modulation and data multiplexing.
5	Evaluate baseband transmission issues including ISI, line coding, and pulse shaping methods.
6	Understand the core blocks of communication systems and evaluate system performance using noise metrics.

Module	Theory Course Contents	Hrs
1	**Introduction to Electronic Communication**	**04**
1.1	Overview of the electromagnetic spectrum and the foundational block diagram of analog communication systems.	
1.2	Examination of the necessity for modulation and fundamental noise metrics (SNR, noise factor, noise figure, and noise temperature).	
2	**Analog Modulation Systems**	**12**
2.1	Principles of Amplitude Modulation (AM), mathematical/graphical representation, frequency spectra, power distribution, and complex modulating signals.	
2.2	Specialized AM types: Generation of DSB-SC using balanced modulators and SSB via phase-shift methods.	
2.3	Angle modulation theory covering Frequency Modulation (FM), Phase Modulation (PM), spectral analysis, noise triangles, pre-emphasis, and de-emphasis.	
2.4	Comprehensive comparison between AM, FM, and PM systems.	
3	**Radio Transmitters and Receivers**	**04**
3.1	Architectural block diagrams for standard AM and FM radio transmitters.	
3.2	Radio receiver characteristics, the Superheterodyne receiver framework, diode detectors, Automatic Gain Control (AGC), and Automatic Frequency Control (AFC).	
4	**Pulse Modulation**	**05**
4.1	Fundamentals of the sampling theorem and signal quantization.	
4.2	Generation and detection mechanisms for Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), and Delta Modulation (DM).	
4.3	Multiplexing strategies focusing on Time Division Multiplexing (TDM with the T1 carrier system) and Frequency Division Multiplexing (FDM).	
5	**Pulse Shaping for Optimum Transmission**	**04**
5.1	Line codes, their desired operational properties, and the mechanics of correlative coding (duo-binary and modified duo-binary encoding).	
5.2	Intersymbol Interference (ISI), eye diagrams, Bit Error Rate (BER), Quality Factors, and the Nyquist Bandwidth.	
5.3	Equalization strategies emphasizing linear equalizers.	
6	**Digital Modulation Techniques**	**10**
6.1	Core advantages of digital communication schemes over analog counterparts.	
6.2	Generation, detection, signal space diagrams, power spectral density, and spectral efficiency analysis for BPSK, QPSK, M-ary PSK, BASK, QAM, BFSK, and MSK.	
	Total	**39**

Textbooks:	
1	Simon Haykin, "Communication System", John Wiley And Sons ,4th Ed
2	Taub Schilling & Saha, "Principles Of Communication Systems", Tata Mc-Graw Hill, Third Ed
3	Kennedy and Davis "Electronics Communication System", Tata McGraw Hill
4	T. L. Singal, "Analog and Digital Communication," Tata Mc-Graw Hill, New Delhi, First Edition, 2012.
5	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	Haykin Simon, "Digital Communication Systems," John Wiley and Sons, New Delhi, Fourth Edition, 2014.
6	Proakis & Salehi, "Communication System Engineering", Pearson Education.

Department of Electronics and Computer Science

Communication Systems (Lab)

Lab Objectivess:	
1	To provide practical training in performing hardware implementations of various analog and digital modulation techniques.
2	To guide students in illustrating the generation and detection processes of diverse pulse modulation techniques.
3	To enable students to apply methods for intentionally introducing Inter-Symbol Interference (ISI) and implementing strategies to mitigate its effects.
4	To equip students with simulation skills to model and analyze various analog and digital modulation methods.
5	To demonstrate the concepts and execution of multiplexing and demultiplexing using standard signal multiplexing techniques.
6	To explore and analyze the impact of varying sampling frequencies on signal reconstruction quality.

Lab Outcomes: After successful completion of the lab 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.
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 Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Analog Modulation and demodulation: AM
2	Analog Modulation and demodulation: FM
3	Pre-emphasis & De-emphasis
4	Analog Pulse modulation (PAM/PWM/PPM)
5	Time division multiplexing
6	Frequency division multiplexing
7	Generation of Line codes
8	Binary modulation and demodulation of BASK
9	Binary modulation and demodulation of BPSK
10	Binary modulation and demodulation of BFSK
Simulation-based experiments	
11	Simulation of AM and FM
12	Simulation of PAM, PPM, PWM
13	Simulation of BPSK/BASK/MSK modulation
14	Simulation of duo binary encoder, decoder

Internet of Things

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECMM51	Internet of Things (Theory)	03	---	---	03	---	---	03
26ECMML51	Internet of Things (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Microprocessor and Microcontroller, Embedded System and RTOS

Course Objectives:

1	To introduce the fundamental concepts, characteristics, communication models, and protocols of the Internet of Things (IoT) and Machine-to-Machine (M2M) communication.
2	To explore various IoT hardware components, including sensors, actuators, RFID, WSN, and exemplary devices like Raspberry Pi.
3	To understand data acquisition, storage, analytics, and cloud computing paradigms used in managing IoT data.
4	To examine web connectivity principles, communication technologies, and specialized IoT application protocols like MQTT, CoAP, HTTP, and LPWAN.
5	To study the structured IoT design methodology, including functional/operational views, device integration, and deployment templates through case studies.
6	To analyze IoT security challenges, layered attacker models, identity management, and secure communication solutions.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Explain the core concepts, characteristics, protocols, and architectural models of IoT and differentiate it from M2M.
2	Identify and utilize hardware components such as sensors, actuators, and single-board computers (like Raspberry Pi) for IoT applications.
3	Analyze data handling techniques, cloud platforms, and cloud-based storage/computing solutions for processing IoT data.
4	Compare and apply appropriate web communication protocols (MQTT, CoAP, HTTP, etc.) and LPWAN technologies for connected devices.
5	Design end-to-end IoT systems by applying structured IoT design methodologies and deployment templates for specific case studies.
6	Evaluate IoT security vulnerabilities, access control mechanisms, and implement secure message communication techniques.

Module	Theory Course Contents	Hrs
1	**Introduction to IoT**	**05**
1.1	Definition and Characteristics of IoT, IoT Protocols, IoT Functional Blocks, IoT Communication Models.	
1.2	IoT Communication APIs: - REST and WebSocket's, IoT Enabling Technologies, Introduction to M2M and Difference between IoT and M2M.	
2	**Components (Things) in IoT**	**05**
2.1	Sensor Technology, Examples of Sensors.	
2.2	Actuators, Applications of RFID and WSN in IoT, Exemplary Device: - R–Pi and its Interfaces, PCDuino, Beagle Bone	
3	**Data Handling in IoT**	**09**
3.1	Data Acquiring and Storage, Organizing the Data, Transactions and Business Processes, Analytics.	
3.2	Data Collection, Storage and Computing Using Cloud Platform.	
3.3	Introduction to Cloud Computing, Virtualization, Cloud Models, Cloud Services.	
4	**Design Principles for Web Connectivity**	**10**
4.1	Communication Technologies – A comparison.	
4.2	Web Communication Protocols for connected devices: - CoRE Environment, CoAP, LWM2M, MQTT, XMPP, HTTP, SOAP Protocols.	
4.3	LPWAN Fundamentals: LORA and NBIoT.	

5	**IoT Design Methodology**	**06**
5.1	Defining Specifications About: - Purpose & requirements, process, domain model, information model, service, IoT level, Functional view, Operational view, Device and Component Integration, Case Study on Home automation, Case Study on Weather Monitoring.	
5.2	IoT Levels and Deployment Templates.	
6	**IoT Security and Vulnerabilities Solutions**	**04**
6.1	IoT Security Tomography and Layered Attacker Model	
6.2	Identity Management, Establishment, Access Control and Secure Message Communication.	
Total		**39**

Textbooks:	
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.
3	David Hanes, Gonzalo Salgueiro ―IoT Fundamentals Networking Technologies, Protocols and Use Cases for Internet of Things‖, Cisco Press, Kindle 2017 Edition.
4	Andrew Minteer, ―Analytics for the Internet of Things (IoT)‖, Kindle Edition.
Reference books:	
1	Adrian McEwen, Hakim Cassimally: Designing the Internet of Things‖, Paperback, First Edition.
2	Yashvant Kanetkar, Shrirang Korde : Paperback ―21 Internet of Things (IOT) Experiments, BPB Publications.

Internet of Things (Lab)

Lab Objectives:	
1	To provide hands-on experience in interfacing various sensors and actuators with single-board computers (such as Raspberry Pi).
2	To train students in acquiring, organizing, and transmitting data from IoT edge devices to cloud platforms.
3	To implement and analyze lightweight web communication protocols (such as MQTT and HTTP) for connected devices.
4	To guide students through the practical implementation of the IoT design methodology for real-world applications (e.g., home automation, weather monitoring).
5	To explore cloud-based storage, computing, and data visualization services for monitoring IoT networks.
6	To demonstrate security mechanisms, such as access control and secure message communication protocols, in an IoT environment.

Lab Outcomes: After successful completion of the lab course students will have:	
1	Interface and program hardware components like sensors and actuators using single-board computers.
2	Collect, manage, and push real-time sensor data from edge nodes to cloud storage platforms.
3	Implement and evaluate communication protocols like MQTT and HTTP for data transmission between IoT devices.
4	Design and prototype complete IoT solutions using structured design methodologies for application scenarios like home automation and weather monitoring.
5	Utilize cloud services for data storage, computational analysis, and graphical dashboard visualization.
6	Configure and test basic security implementations, including access controls and secure data communication channels for IoT deployments.

Suggested Experiments: Students are required to complete at least 08 experiments.

Sr.No.	Name of the Experiments
1	Introduction to Arduino/Raspberry Pi/ESP32: Pin configuration, IDE setup, and basic programming
2	Blinking LED using Arduino/ESP32: Digital output pin control
3	Interfacing Temperature Sensor (e.g., LM35 or DHT11): Analog/Digital sensor read and display on serial monitor
4	Interfacing Motion Sensor (PIR): Motion detection and triggering an alert (e.g., buzzer or LED)
5	Interfacing Gas Sensor (MQ2/MQ135): Gas level detection and real-time monitoring
6	Sending Sensor Data to a Mobile Device via Bluetooth (HC-05): Simple data logging or monitoring via a mobile app
7	Sending Sensor Data to ThingSpeak/Adafruit IO: Cloud dashboard setup and data visualization
8	Case study on advance topic -Smart Energy Meter using IoT: Measure voltage, current, and send data to cloud
9	Case study of recent development in the subject -IoT-Based Health Monitoring System Integrate heartbeat, SpO2, and temperature sensors with cloud display

OPEN ELECTIVES (NPTEL COURSES)
COURSE NAME: - GERMAN-II

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE51	German-II (Theory)	Online	---	---	04	---	---	04
							Total Credits	04

About the Course:
German II builds upon German I to help the learner acquire the A level of competence (A1+A2) as per the European Common Language Framework. It is meant to broaden and deepen the learner's understanding of German grammatical structures, further enrich her vocabulary to cover all aspects of daily living, and to develop a basic understanding of the German cultural space. Serious learners should be able to get a comprehensive understanding of basic German grammar, and build a good enough vocabulary to be able to articulate themselves in any given daily life situation, and about basic themes of personal interest.

Course Objectives

The course objectives define what the instructor intends to cover and achieve throughout the 12-week duration:

1. **To equip students** with intermediate-level German vocabulary, thematic expressions, and structural patterns relevant to daily life, professional environments, and social interactions.
2. **To develop advanced grammatical competence**—including complex sentence structures (subordinate clauses with *weil, dass, wenn, als*), adjective declensions, the subjunctive mood, and changing prepositions.
3. **To enhance multi-faceted language proficiency** covering reading comprehension, listening, writing (invitations, reflections, descriptions), and spontaneous spoken communication.
4. **To foster intercultural awareness** by exploring topics related to European/German traditions, school and work culture, media consumption, and social habits.
5. **To prepare learners** to independently navigate practical real-world scenarios in a German-speaking environment (such as travel, housing, academics, and professional settings).

Course Outcomes (COs)

CO1: Understand and Discuss Daily Life & Social Environments
Description: Express personal habits, feelings, and cultural preferences regarding cooking, cuisine, school systems, media, sports, and living arrangements using appropriate vocabulary and accurate grammatical structures (reflexive verbs, modal past tenses, and comparative forms).

CO2: Construct Complex Sentences and Grammatical Modifiers
Description: Apply intermediate grammatical rules—such as adjective declensions, possessive articles in dative case, and dative/accusative verb governance—to construct grammatically correct written and spoken sentences.

CO3: Navigate Professional, Travel, and Public Scenarios
Description: Comprehend and utilize terminology related to professions, public transport, train travel, and work commutes, while utilizing auxiliary verbs (like *werden*) and directional prepositions accurately.

CO4: Compose Social Communications and Structured Presentations
Description: Write formal and informal correspondence (such as event invitations, responses, and descriptions of images/media) and structure academic or personal presentations utilizing subjunctive moods and relative clauses.

CO5: Analyze Complex Textual and Contextual Structures
Description: Interpret advanced linguistic nuances including conditional clauses (*if/wenn*), temporal/causal relationships (*als/wenn*), and subjunctive forms in spoken or written texts to respond critically in diverse cultural contexts.

Week No.	Contents
1	Cooking and cuisine, eating habits, expressing feelings / Grammar : clauses with 'because', reflexive verbs, possessive articles with dative
2	School and after, subjects, school types / Grammar : past tense of modal verbs, changing prepositions – position and movement
3	Media in daily life, film / Grammar: comparative and superlative, clauses with 'that'.
4	Festivals and events, invitations and responses / Grammar: clauses with 'if', adjective declension.
5	Professions, work, train travel / Grammar: adjective declension, the verb 'werden'.
6	Public transport, cars, getting to work / Grammar: clauses and prepositions.
7	Learning, presentations, exams / Grammar: subjunctive, genitive.
8	Sports, fans / Grammar: clauses, verbs with dative and accusative.
9	Living, shifting, conflicts at home, pets / Grammar: subjunctive, 'als' and 'wenn'.
10	Music, describing pictures / Grammar: interrogative 'what kind of, indefinite pronouns, relative clauses.
11	Time / Grammar: subjunctive, verbs with prepositions, W questions with prepositions.
12	Festivals, stereotypes / Grammar: clauses, relative clauses.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

COURSE NAME: SOFT SKILLS

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE52	Soft Skills (Theory)	Online	---	---	04	---	---	04
Total Credits								04

About the Course:

Soft Skills, a buzz word today has attracted the attention of students, professionals and entrepreneurs all over the world. Employability, being the major concern today, every individual aims at getting coveted jobs. Employability today is commensurate with proving multiple skills in varied situations in a fast changing world. Hence, everyone aspiring for jobs today has to prove one's mettle in various situations where one requires to be armed with different skills, which, collectively come under Soft Skills. One may be armed with good competence of one's subject but one cannot compete with his peer groups unless one has the potential of performance. Performance can be ensured with the demonstration of certain abilities that can help a professional communicate, corroborate, convince, evaluate and look into the continuing as well as the upcoming trends of the corporate world from time to time. The course aims at creating awareness among the stock holders of the corporate world in which the role of individuals as team players and also as responsible leaders materializes to a great extent. The course, with its interactive and need based modules, will address various challenges of communication as well as behavioural skills faced by individuals at workplace and organizations in bridging the gaps through effective skills of interviews, group discussions, meeting management, presentations and nuances of drafting various business documents for sustainability in today's global world.

Course Objectives

1. Enhance Communication Proficiency: Develop clear, concise, and impactful verbal, non-verbal, written, and telephonic communication skills.
2. Foster Professional Behaviour & Ethics: Cultivate positive thinking, emotional intelligence, critical thinking, adaptability, and strong work ethics.
3. Build Leadership & Team Dynamics: Train students in group discussions, meeting management, negotiation, and effective leadership.
4. Master Business Documentation: Provide hands-on training in drafting professional business letters, official reports, and high-impact résumés.
5. Excel in Professional Presentations & Interviews: Prepare students to deliver compelling oral presentations and successfully navigate job interviews while overcoming nervousness.

Course Outcomes (CO)

Upon successful completion of this course, students will be able to:

CO1: Demonstrate foundational soft skills, self-awareness, and professional communication styles (written, verbal, and non-verbal).

CO2: Apply advanced writing and formatting techniques for business letters, technical reports, and professional correspondence.

CO3: Exhibit effective cross-cultural communication, active listening, and organizational communication strategies.

CO4: Lead and participate productively in group discussions, meetings, and team negotiations.

CO5: Design and deliver professional oral presentations using advanced public speaking techniques and robust visual planning.

CO6: Apply emotional intelligence, critical thinking, and structured interview strategies to successfully secure and sustain employment.

Week No.	Contents
1	Introduction to Soft Skills, Aspects of Soft Skills, Effective Communication Skills, Classification of Communication, Personality Development.
2	Positive Thinking, Telephonic Communication Skills, Communicating without Words, Paralanguage.
3	Proxemics, Haptics: The Language of Touch, Meta-communication, Listening Skills, Types of Listening.
4	Negotiation Skills, Culture as Communication, Organizational Communication.
5	Communication Breakdown, Advanced Writing Skills, Principles of Business Writing.
6	Business Letters, Business Letters: Format and Style, Types of Business Letter.
7	Writing Reports, Types of Report, Strategies for Report Writing, Evaluation and Organization of Data.
8	Structure of Report, Report Style, Group Communication Skills.
9	Leadership Skills, Group Discussion, Meeting Management, Adaptability & Work Ethics.
10	Advanced Speaking Skills, Oral Presentation, Speeches & Debates, Combating Nervousness, Patterns & Methods of Presentation, Oral Presentation: Planning & Preparation.
11	Making Effective Presentations, Speeches for Various Occasions, Interviews, Planning & Preparing: Effective Résumé.
12	Facing Job Interviews, Emotional Intelligence & Critical Thinking, Applied Grammar.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

COURSE NAME: -PUBLIC SPEAKING

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE53	Public Speaking (Theory)	Online	---	---	04	---	---	04
Total Credits								04

About the Course:
Speaking has since ages been an innate human quality. In a contemporary globalized world, effective public speaking has become crucial both at individual and organizational levels. Public speaking as verbal talent posits itself as a "cause" with clear motive to "effect" the intended audience. It enables the speaker to have direct impact upon the audience and thus makes it an effective medium to exercise in diverse situations. However, not all the speakers are able to create the intended effect through their act of speaking due to their unfamiliarity with speech techniques and delivery nuances. Many of us, though competent enough, often feel anxiety about speech when called upon to speak in personal and public domains such as interviews, presentations, meetings, conferences, group discussions and many speaking related challenges in the present day ever changing corporate world. The purpose of this public speaking course is to develop the speech and personality of learners in order to convert them into confident, committed and effective speakers. The course will serve as a guide to various forms of public speaking with relevance to numerous emerging situational contexts and provide an overall development in speech delivery in a perspicuous manner.

Course Objectives

1. **To introduce foundational principles** of effective communication, public speaking frameworks, and the transition from conceptual thinking to practical execution.
2. **To develop performance-oriented speaking skills** by emphasizing vocal delivery, body language, and the strategic use of non-verbal cues.
3. **To equip students** with specialized oral communication techniques required for diverse professional contexts, including interviews, meetings, conferences, and formal presentations.
4. **To enhance expressive capabilities** through the creative use of language, rhetorical devices, and audience-tailored speech structuring.
5. **To instill professional etiquette,** audience awareness, and poise across various public speaking and corporate interaction environments.

Course Outcomes (COs)

CO1: Understand the Foundations and Prerequisites of Public Speaking
Description: Comprehend the core principles, psychological readiness, and methodologies required to transform abstract ideas into structured, actionable public speeches.

CO2: Apply Performative and Non-verbal Communication Strategies
Description: Demonstrate effective stage presence by integrating appropriate body language, posture, gestures, and vocal modulation into speech delivery.

CO3: Design and Deliver Diverse Types of Speeches
Description: Categorize, prepare, and present various speech formats (such as informative, persuasive, and demonstrative speeches) tailored to specific target audiences.

CO4: Navigate Professional Interactions and Presentations
Description: Execute professional oral presentations, manage formal meetings/conferences, and articulate responses effectively during high-stakes job or academic interviews.

CO5: Utilize Creative Language and Professional Etiquette
Description: Employ stylistic and creative language devices to engage listeners while adhering to accepted corporate etiquette, decorum, and professional mannerisms in public forums.

Week No.	Contents
1	Introduction to the Course
2	Prerequisites for Public Speaking
3	Converting Ideas into Action
4	Public Speaking as a Performative Act
5	Use of Non-verbal in Public Speaking
6	Types of Public Speaking
7	Speeches: Types and Demonstrations
8	Interviews
9	Meetings and Conferences
10	Oral/Professional Presentation
11	Creative Use of Language in Public Speaking
12	Etiquettes and Mannerism in Public Speaking

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

Business To Business Marketing (B2B)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE54	Business to Business Marketing (B2B) (Theory)	Online	---	---	04	---	---	04
Total Credits								04

About the Course:
Business to Business Marketing (B2B) has been one of the most discussed topics in marketing. It involves all kinds of industries be it manufacturing or service oriented ones. It encompasses small, medium and large industries and creates employment for large number of people. Business organizations have been constantly trying to optimize their processes and products in order to provide better products and services to other firms and thus constant innovation in such organizations has been the norm. With growing technology, better transport facilities and advanced research it has grown at a much faster pace in comparison to others.
This course aims at building a strong theoretical base as well as enhances the learner's knowledge on designing successful business strategies and programs. As a part of this course, case studies from across the globe would be used to bring in an experiential learning among the learners.

Course Objectives
1. **To introduce foundational concepts** of Business-to-Business (B2B) marketing, highlighting the distinctions between business and consumer (B2C) markets, market structures, and customer profiles.
2. **To analyze organizational buyer behavior** and decision-making processes, including strategic procurement frameworks and government/institutional buying.
3. **To develop strategic competence** in formulating B2B marketing strategies, market segmentation, targeting, positioning (STP), and portfolio management models.
4. **To equip students** with tactical operational skills covering industrial product/service management, pricing strategies, demand forecasting, marketing communications, and channel/logistics management.
5. **To foster managerial decision-making** concerning buyer-seller relationships, B2B marketing research, CRM, and strategic resource allocation in industrial markets.

Course Outcomes (COs)

CO1: Comprehend B2B Market Dynamics and Organizational Buyer Behavior
Description: Understand the distinct characteristics of business markets, commercial enterprises, and institutional customers, and analyze the stepwise processes of organizational buying behavior and strategic procurement.

CO2: Formulate B2B Marketing Strategies and STP Frameworks
Description: Develop industrial product, service, and channel strategies using portfolio matrices (Growth-Share, Multifactor, Balanced Scorecard) and execute effective business market segmentation, targeting, and positioning.

CO3: Manage Industrial Product Lines, Innovations, and Demand Forecasting
Description: Apply industrial product life cycle concepts, new product development techniques (such as QFD, perceptual mapping, and reverse engineering), and qualitative/quantitative models to forecast industrial market demand.

CO4: Design Pricing, Communication, and Logistics Strategies for Business Markets
Description: Formulate competitive pricing policies, bidding strategies, B2B advertising, digital marketing, trade show deployments, and efficient supply chain/logistics management plans.

CO5: Evaluate Buyer-Seller Relationships and Strategic Decision-Making
Description: Assess transactional and collaborative relationship dynamics, implement CRM practices, conduct B2B marketing research, and evaluate strategic planning and resource allocation at the corporate and SBU levels.

Week No.	Contents
1	Introduction to B2B Marketing: Business marketing, Classifying goods for the business market, Business market customers, Market structure, Environment and Characteristics of Business Marketing, Strategic role of marketing, Commercial enterprises, Commercial and institutional customers, B2B vs B2C Marketing.
2	Organizational Buying and Buyer Behaviour: Organizational buyers' decision process - A Stepwise Model and A Process Flow Model, Organizational and business markets - Government as a customer - Commercial enterprises - Commercial and institutional customers, Value analysis, Buygrid framework, Strategic procurement.
3	B2B Marketing Strategy: Strategy making and strategy management process, Industrial product strategy– Managing Products for Business Markets-Managing Services for Business Markets-Managing Business Market channels The Growth-Share Matrix, Multifactor Portfolio Matrix, The Balanced Scorecard.
4	B2B Marketing STP: Market Segmentation, bases for segmenting business markets, basic framework of segmentation, choosing target segments and positioning.

5	Business Marketing Communications- B2B Advertising, Digital marketing,- Trade shows, exhibitions, business meets - Managing the sales force - Deployment analysis, Direct marketing.
6	Demand forecasting: industrial market, Forecasting- meaning, importance and relevance, issues related to forecasting, forecasting measurement models, sales force forecasting, estimating segment demand, Collaborative approach to estimate demand, qualitative and quantitative forecasting methods.
7	Product management: (existing and new) in industrial market, role of product in the industrial market, new product development, industrial product life cycle, product evaluation matrix, techniques for identifying new products QFD, perceptual mapping, reverse engineering, fish bone diagram, role of service and maintenance in industrial markets, customer experience life cycle, service quality.
8	Pricing: Pricing strategies; The pricing policy; Price on the Internet; Financial marketing, competitive bidding, commercial terms and conditions, role of leasing.
9	Buyer seller relationship, types of relationships, transactional and collaborative relationships, influencing industrial customers, role of service in industrial markets. CRM.
10	B2B marketing research, challenges in B2B research, developing a marketing information system, role of qualitative research techniques in B2B research.
11	Business marketing channels and participants - Channel design and management decisions -B2B logistics management, types of industrial middlemen And intermediaries, marketing logistics and physical distribution.
12	Strategic decision making in industrial markets, strategic planning at corporate levels, allocation of resources, portfolio analysis, developing SBU'S objectives and goals, implementing and controlling marketing plan. Marketing through electronic commerce.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

PRIVACY AND SECURITY IN ONLINE SOCIAL MEDIA

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE55	Privacy and Security in Online Social Media (Theory)	Online	---	---	04	---	---	04
Total Credits								04

About the Course:
With increase in the usage of the Internet, there has been an exponential increase in the use of online social media and networks on the Internet. Websites like Facebook, YouTube, LinkedIn, Twitter, Flickr, Instagram, Google+, FourSquare, Pinterest, Tinder, and the likes have changed the way the Internet is being used. However, widely used, there is a lack of understanding of privacy and security issues on online social media. Privacy and security of online social media need to be investigated, studied and characterized from various perspectives (computational, cultural, psychological, etc.). Student completing the course will be able to appreciate various privacy and security concerns (spam, phishing, fraud nodes, identity theft) on Online Social Media and Student will be able to clearly articulate one or two concerns comprehensively on one Online Social Media, this will be achieved by homework.

Course Objectives

1. **To introduce the foundations** of Online Social Networks (OSNs) and Online Social Media (OSM), focusing on data collection methodologies, APIs, and the inherent challenges and opportunities in the digital social space.
2. **To examine trust, credibility, and reputation mechanisms** within social systems and analyze how trustworthiness is established or compromised online.
3. **To explore security, privacy, and policing aspects** of social media, including information disclosure behaviors, data privacy effects, and law enforcement applications.
4. **To equip students** with threat-detection skills to identify cyber threats such as phishing campaigns and fraudulent entities operating within OSNs.
5. **To foster advanced research and analytical competencies** through the critical review, discussion, and contextual evaluation of cutting-edge research papers in the domain of social network security and privacy.

Course Outcomes (COs)

CO1: Understand OSN Architectures and Data Collection Methodologies
Description: Comprehend the foundational concepts of online social networks, navigate platform APIs, and identify the technical and ethical challenges, opportunities, and pitfalls involved in collecting data from OSNs and OSM.

CO2: Evaluate Trust, Credibility, and Reputation in Social Systems
Description: Analyze how trust, credibility, and reputation are built, maintained, or distorted within digital communities and social system frameworks.

CO3: Analyze Information Privacy, Disclosure, and Social Media Policing
Description: Investigate user information disclosure behaviors, the secondary effects of data revelation in online social networks, and the role, methods, and implications of social media policing.

CO4: Detect Phishing and Fraudulent Entities in Social Networks
Description: Apply security principles and detection techniques to identify phishing threats, malicious profiles, and fraudulent entities actively exploiting online social network vulnerabilities.

CO5: Critically Review and Discuss Advanced Research in OSNs
Description: Synthesize, critique, and present contemporary findings from peer-reviewed research papers addressing complex security, privacy, and analytical challenges in modern online social media.

Week No.	Contents
1	What is Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks, APIs.
2	Collecting data from Online Social Media.
3	Trust, credibility, and reputations in social systems.
4	Trust, credibility, and reputations in social systems.
5	Online social Media and Policing.
6	Information privacy disclosure, revelation and its effects in OSM and online social networks
7	Phishing in OSM & Identifying fraudulent entities in online social networks
8	Refresher for all topics
9 to 12	Research paper discussion

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

GERMAN-I

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE56	German-I (Theory)	Online	---	---	04	---	---	04
Total Credits								04

About the Course:
German I is meant to be an introduction to the German language and a basic orientation towards Germany (and to some extent Austria and Switzerland).Learning to understand and articulate oneself in day to day real life situations, and to begin to make sense of Germany as a cultural space are the overall objectives of the course. Serious learners should be able to grasp the basic sentence structure and build a good foundational vocabulary through this course.

Course Objectives

1. **To introduce foundational German vocabulary** and thematic expressions necessary for basic daily interactions, self-introduction, and social introductions.
2. **To develop essential grammatical competence**—including basic sentence structures, verb conjugations (present and past tenses), cases (nominative, accusative, and dative), and modal verbs.
3. **To equip learners** with practical communication skills required to navigate everyday situations such as shopping, transportation, housing, telling time, and making appointments.
4. **To build fundamental reading, writing, and listening proficiency** through simple text comprehension, letter writing, and describing immediate surroundings (city, home, family, hobbies).
5. **To foster basic intercultural awareness** by exploring lifestyle elements, habits, celebrations, and routines in German-speaking environments.

Course Outcomes (COs)

CO1: Introduce Oneself and Communicate Basic Personal Information
Description: Express basic personal details, hobbies, family structures, and routine information using W-questions, personal pronouns, and present-tense verb conjugations.

CO2: Navigate Daily Social and Urban Environments
Description: Comprehend and utilize vocabulary related to city navigation, public transport, food, drink, and leisure activities while correctly applying definite/indefinite articles, negation (*nicht/kein*), and the accusative case.

CO3: Manage Temporal and Practical Appointments
Description: Tell time, schedule appointments, and discuss daily routines using appropriate temporal prepositions (*am, um, von...bis*) and modal verbs.

CO4: Describe Living Spaces, Professions, and Immediate Surroundings
Description: Describe apartments, rooms, furniture, clothing, and professional backgrounds using changing prepositions, dative cases, and past/perfect tenses.

CO5: Compose Simple Correspondence and Handle Health/Travel Scenarios
Description: Write basic social letters and communicate health concerns, holiday plans, and weather conditions utilizing the imperative mood and descriptive vocabulary.

Week No.	Contents
1	Themes: Introducing oneself and others; Grammar: W questions, personal pronouns, simple sentence, verb conjugation.
2	Themes: hobbies, the week, numbers, the alphabet, months, seasons /Grammar: articles, plural, the verbs to have and to be.
3	Theme: In the city / naming places and buildings, means of transport, basic directions / Grammar: definite and indefinite articles; negation - kein and nicht; imperative.
4	Themes: food, drink, family / groceries and meals / Grammar : the accusative
5	Theme: Everyday life, telling time, making appointments / Grammar: prepositions am, um, von..bis; modal verbs, possessive articles.
6	Leisure activity, celebrations / Grammar: separable verbs, the accusative, past tense of to have and to be.
7	Contacts, writing letters / Grammar: dative.
8	My apartment, rooms, furniture, colours / Grammar: changing prepositions.
9	Professions / Grammar: perfect tense.
10	Clothes / Grammar: perfect tense and dative.
11	Health and the body / Grammar: the imperative and modal verbs.
12	Holiday and weather.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

E-Business

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE57	E-Business (Theory)	Online	---	---	04	---	---	04
Total Credits								**04**

About the Course:
The Internet has changed the way companies carry out their businesses. The primary objective of this course is to introduce concepts, tools and approaches to electronic business to the post-graduate and undergraduate students. Further, the subject will help the students to develop skills to manage businesses in the digital world. The course will cover following aspects of E-Business Systems.

- Part 1: Foundations of E-Business systems
- Part 2: Infrastructure
- Part 3: Functional Areas
- Part 4: Decision Support for E-Business Systems

The course provides a balance approach including concepts from technology and management.

Course Objectives

1. **To introduce foundational concepts** of E-Business, tracing its evolution and strategic importance in modern corporate landscapes.
2. **To examine how functional areas** of a business are e-business enabled, focusing on enterprise resource planning (ERP), value chains, supply chains, e-procurement, and digital marketing/selling.
3. **To explore the underlying technologies** powering e-business systems, including internet frameworks, secure electronic payment gateways, web security, and advanced supply chain integration tools (EDI, IoT, RFID, Cloud).
4. **To equip students** with decision-support analytics methodologies, including web analytics, customer behavior modeling, online auctions, and recommender systems.
5. **To foster managerial and analytical competencies** necessary to design, secure, and optimize e-business operations across enterprise structures.

Course Outcomes (COs)

CO1: Comprehend E-Business Foundations and Functional Enablement
Description: Understand core e-business models and analyze how traditional organizational functional areas (such as procurement, supply chain, and marketing) are transformed and integrated using ERP systems.

CO2: Evaluate E-Procurement and Digital Marketing Strategies
Description: Assess electronic procurement frameworks, digital sales channels, and e-marketing strategies designed to optimize intra- and inter-organizational business processes.

CO3: Apply Core Technologies, Security, and Payment Mechanisms
Description: Examine internet-based system architectures, secure digital payment gateways, and security protocols required to protect electronic transactions and commercial data.

CO4: Integrate Modern Supply Chain Technologies
Description: Utilize advanced supply chain integration technologies—such as Electronic Data Interchange (EDI), RFID, IoT sensors, GIS/GPS, web services, and cloud computing—to streamline enterprise operations.

CO5: Design Decision-Support Systems and Analytics Models
Description: Formulate web analytics metrics, model customer behavior, evaluate online auction formats, and design recommender systems to drive data-backed decision-making in e-business environments.

Week No.	Contents
1	Introduction to E-Business.
2	Making Functional Areas E-Business Enabled: Value chain and supply chain, inter and intra organizational business processes, ERP.
3	Making Functional Areas E-Business Enabled: E-Procurement.
4	Making Functional Areas E-Business Enabled: E-marketing, E-Selling, E-Supply Chain Management.
5	Technologies for E-Business: Internet and Web based system.
6	Technologies for E-Business: Security and payment systems.
7	Technologies for E-Business: Supply chain integration technologies (EDI, RFID, Sensors, IoT, GPS, GIS).
8	Technologies for E-Business: Supply chain integration technologies (Web services and cloud).
9	Decision Support in E-Business: Web analytics.
10	Decision Support in E-Business: Customer behavior modeling.
11	Decision Support in E-Business: Auctions.
12	Decision Support in E-Business: Recommender systems.

CRITERIA TO GET A CERTIFICATE

Average assignment score = 25% of average of best 8 assignments out of the total 12 assignments given in the course.
Exam score = 75% of the proctored certification exam score out of 100

Final score = Average assignment score + Exam score

Department of Electronics and Computer Science

Open Electives (NPTEL Courses)

Teaching Scheme								
Course Code	Course Name	Course Duration			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECOE5X	Online Open Elective (Theory)	12 weeks	–	---	04		---	04

Examination Scheme							
Course Code	Course Name	Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Semester Exam			
		Mid-Term Test	Continuous Assessment				
26ECOE5X	Online Open Elective (Theory)	---	---	100*	---	---	100

(*marks will be allotted based on the consolidated score awarded by NPTEL*)

Mode of Learning: Online (NPTEL / SWAYAM Platform)
Nature of Course: Self-learning (MOOC)
Assessment: NPTEL Certification There will be no Internal Assessment (CA) and no End Semester Examination (ESE) conducted by the Institute. Credits awarded based on NPTEL certificate
List of Courses: Will be announced as per the schedule of NPTEL, which is normally before the commencement of the respective semesters
Important Note: The syllabus would be as prescribed by NPTEL for the selected list of courses by the Department.

Textbooks / Learning Resources :

1. Video lectures
2. Weekly assignments
3. Reference material uploaded by the course instructor

Rules for Open Elective (OE) – Semesters 4 and 5

1. **Course Registration & Certificate Submission**

Students must register and submit the passing certificate of an NPTEL course chosen from the department-suggested list.

2. **Mode of Learning**

The NPTEL course must be completed independently by the student (self-learning mode).

3. **Assignments & Examination**

Students must timely submit all NPTEL assignments and appear for the NPTEL proctored exam.

4. **Credit Awarding**

After successfully passing the NPTEL course, 4 credits will be awarded on production of certificate from NPTEL.

5. **Fees**

NPTEL courses are free for enrollment, but the exam fees must be borne by the student.

6. **SWAYAM Local Chapter Registration**

During NPTEL registration, students must:

- Select YES for "Are you part of a SWAYAM Local Chapter?"
- Choose the college name from the list. (College Code: 2173)

7. **ABC Account & APAAR ID**

Students must mention their ABC Account Number and APAAR ID in their Profile detail.

8. **Fail / Absent in NPTEL Exam**

- Students who fail or remain absent must reappear in the next NPTEL re-exam (generally conducted after 6 months).
- If the course is not re-run in the next cycle, the student must choose another course from the department-approved NPTEL list.

9. **Result & Mark sheet**

- The grading system for Open Elective subjects will remain the same as other subjects.

- If the student fails to pass the subject in the respective semester, against the Open Elective subject No Certificate (NC) would be indicated in the mark sheet, they would loose the grade points of the subject.
- Credits will be awarded as and when the student submits the certification from NPTEL.
- The students who are not able to produce NPTEL certification till the end of 8th semester are bound to clear OE offered by the Institute in the next academic year whose exams will be conducted offline.
- Student shall be permitted to appear for the offline Open Elective examination conducted by the Institute only if they have attempted the corresponding NPTEL examinations at least twice and were unable to pass.

Department of
Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-VI
A.Y. 2026-27

Semester VI Teaching Scheme

Course Type	Course code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
			TH	PR	TUT	TH	PR	TUT	TOTAL
PCC	26ECPC61/ 26ECPCL61	Analog VLSI	3	2	---	3	1	---	4
PCC	26ECPC62/ 26ECPCL62	Computer Communication and Networking	3	2	---	3	1	---	4
PEC	26ECPE26X/ 26ECPE2L6X	Program Elective 2	3	2	---	3	1	---	4
PEC	26ECPE36X/ 26ECPE3L6X	Program Elective 3	3	2	---	3	1	---	4
MDM	26ECMM61	IIoT & Industry 4.0	2	---	---	2	---	---	2
VSE	26ECVSEL61	ASIC Design Lab	---	2	1	---	1	1	2
CP	26ECCP161	Capstone Project-I	---	4	---	---	2	---	2
	Total Credits								**22**

Semester VI Marks Scheme

Course Type	Course code	Course Name	TH	MT	CA	TW	PR/OR	TOTAL
PCC	26ECPC61/ 26ECPCL61	Analog VLSI	60	20	20	25	25	150
PCC	26ECPC62/ 26ECPCL62	Computer Communication and Networking	60	20	20	25	25	150
PEC	26ECPE26X/ 26ECPE2L6X	PEC 2	60	20	20	25	25	150
PEC	26ECPE36X/ 26ECPE3L6X	PEC 3	60	20	20	25	25	150
MDM	26ECMM61	IIoT & Industry 4.0	60	20	20	---	---	100
VSE	26ECVSEL61	ASIC Design Lab	---	---	---	25	25	50
CP	26ECCP161	Capstone Project-I	---	---	---	50	50	100
	Total Marks							**850**

Program Electives (PEC)

PEC 2	PEC 3
26ECPE261: Software Testing and Quality Assurance	**26ECPE361**: Digital Image Processing
26ECPE262: Machine Learning	**26ECPE362**: Micro Electro-Mechanical Systems
26ECPE263: Data Warehouse and Mining	**26ECPE363**: Principles of Control System

Analog VLSI									
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned				
		TH	PR	Tut	TH	PR	Tut	Total	
26ECPC61	Analog VLSI (Theory)	03	---	---	03	---	---	03	
26ECPCL61	Analog VLSI (Lab)	---	02	---	---	01	---	01	
							Total Credits	04	

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite:	
Digital System Design (NECPC32), Electronic Devices and Circuits, (NECPC41), Digital VLSI (NECPC51).	
Course Objectives:	
1	Introduce integrated circuit biasing principles, including current mirrors and bandgap voltage references.
2	Explain the characteristics and small-signal behavior of single-stage and differential MOS amplifiers.
3	Examine different noise sources and representation techniques in MOS integrated circuits.
4	Detail the analysis and compensation methods for CMOS operational amplifiers and OTAs.
5	Outline fundamental data converter parameters and mixed-signal layout considerations.
6	Analyze various architectures of analog-to-digital (ADC) and digital-to-analog (DAC) converters.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Design precision current mirrors and bandgap reference generators for IC biasing.
2	Analyze the gain, frequency response, and performance of single-stage and differential MOS amplifiers.
3	Evaluate the impact of thermal, flicker, and shot noise on MOS circuit performance.
4	Design CMOS operational amplifiers and apply appropriate stability compensation techniques.
5	Identify mixed-signal layout challenges, power supply issues, and ADC performance metrics.
6	Compare and assess different ADC and DAC architectures such as pipeline, flash, and successive approximation types.

Module	Theory Course Contents	Hrs
1	**Integrated Circuit Biasing Techniques**	**06**
1.1	Simple current mirror, Cascode current mirror.	
1.2	Current and voltage references, Band gap reference generator.	
2	**Single Stage MOS Amplifiers**	**10**
2.1	Common-source stage (with resistive load, diode connected load, current-source load, triode load, source degeneration), source follower, common-gate stage, Cascode stage, folded Cascode stage.	
2.2	Single-ended operation, differential operation, basic differential pair, large-signal and small-signal behavior, common-mode response, differential pair with MOS loads.	
3	**Noise in MOS Circuits**	**04**
3.1	Noise spectrum, correlated and uncorrelated noise sources, thermal noise, flicker noise, shot noise.	
3.2	Representation of noise in circuits, noise in single stage CS.	
4	**CMOS Operational Amplifier**	**06**
4.1	Design of Current Mirror Load Differential Amplifier,	
4.2	Design of two stage Operational Transconductance Amplifier, Opamp Compensation Techniques.	
5	**Data Converter Fundamentals**	**04**
5.1	ADC parameters, Sample and Hold amplifier.	
5.2	Mixed signal Layout issues, Floor planning, Power supply and Ground issues.	
6	**Data Converter Architectures**	**09**
6.1	Charge scaling DACs, Cyclic DAC, Pipeline DAC.	
6.2	Flash ADC, Single Slope Integrating ADC, and Successive approximation ADC	
Total		**39**

Textbooks:	
1	B. Razavi, —Design of Analog CMOS Integrated Circuits, first edition, McGraw Hill, 2001.
2	P.E.Allen and D R Holberg, —CMOS Analog Circuit Design, second edition, Oxford University Press, 2002.
3	R. Jacob Baker, —CMOS Circuit Design, Layout and Simulation, Wiley, 2nd Edition, 2013
Reference books:	
1	Adel S. Sedra, Kenneth C. Smith, A.N. Chandorkar, —Microelectronics Circuits Theory and Applications, Fifth Edition, Oxford University Press.
2	Gray, Meyer, Lewis and Hurst —Analysis and design of Analog Integrated Circuits, 4th Edition Willey International, 2002
3	Tony Chan Carusone, David Johns, Kenneth Martin, — Analog Circuit Design, Second Edition, Wiely

Analog VLSI (Lab)

Lab Prerequisite: Basic VLSI Design	
Lab Objectives:	
1	Familiarize students with industry-standard online tools and simulation environments for analog VLSI design.
2	Provide hands-on experience in characterizing MOSFET devices and evaluating their analog performance parameters.
3	Guide students in designing and simulating precision current mirror biasing circuits.
4	Enable the practical implementation and performance analysis of single-stage and common-source MOS amplifiers.
5	Train students to design and simulate advanced analog blocks including differential amplifiers and OTAs.
6	Introduce physical design concepts by generating and verifying layouts for basic MOS circuits and current mirrors.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Utilize simulation software effectively to set up, analyze, and test analog VLSI circuits.
2	Characterize MOSFET behavior and extract performance metrics for analog applications.
3	Simulate and verify the functionality of various current mirror configurations.
4	Analyze the AC and DC characteristics of common-source and single-stage MOS amplifiers.
5	Evaluate the differential mode and common-mode response of differential amplifiers and operational transconductance amplifiers.
6	Create robust IC layouts for fundamental building blocks while understanding layout constraints.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Use of Online Tools to study analog VLSI circuits
2	Analysis of MOSFETs for analog performance
3	Design and simulate various types of current mirror circuits
4	Design and simulate various common source amplifier circuits
5	Design and simulate various types of single stage amplifiers
6	Design and simulate differential amplifier
7	Design and simulate operational transconductance amplifier
8	Design and simulate mixed mode circuit
9	Generate layout for the simple and Cascode current mirror
10	Generate layout for common source amplifier

Computer Communication and Networking

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPC62	Computer Communication and Networking (Theory)	03	---	---	03	---	---	03
26ECPCL62	Computer Communication and Networking (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Communication System.

Course Objectives:

1	Introduce computer network layers, topologies, and reference models (OSI, TCP/IP).
2	Examine physical media, switching techniques, and core networking hardware devices.
3	Explain data link layer design, error control, and medium access protocols.
4	Detail network layer routing, IP addressing, subnetting, and congestion control.
5	Explore transport layer protocols (TCP/UDP), reliability, and connection management.
6	Analyze standard application layer protocols and client-server architectures.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Compare network architectures using OSI and TCP/IP reference models.
2	Assess physical transmission media, switching types, and network devices.
3	Implement framing, error control, and medium access control for LANs.
4	Design IP addressing and evaluate routing and congestion control algorithms.
5	Analyze TCP and UDP transport mechanisms for reliable communication.
6	Examine core application layer protocols like HTTP, DNS, and FTP.

Module	Theory Course Contents	Hrs
1	**Introduction to Data Communications and Networking**	**05**
1.1	Introduction to computer networks, Layers and services, Network topologies, protocol hierarchies, design issues for the layers, connection oriented and connectionless services.	
1.2	Reference models: Layer details of OSI, TCP/IP models. Communication between layers.	
2	**Transmission Media: Physical Layer**	**06**
2.1	Twisted pair, Coaxial, Fiber optics, Wireless transmission media.	
2.2	Circuit and packet Switching.	
2.3	Network Devices –Repeater, HUB, switch, routers and gateways.	
3	**Data Link Layer**	**08**
3.1	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.	
3.2	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	
4	**Network layer**	**08**
4.1	Network Layer design issues, Communication Primitives: Unicast, Multicast, broadcast. Network Layer Protocols: IPv4 Datagram Format, IPv4 Addresses, IPv4 Addressing (classfull and classless), Sub-netting and Super-netting design problems, IPv4 Protocol, IPv6 Packet Format, IPv6 Addressing, Transition from IPv4 to IPv6.	
4.2	Routing algorithms: Intra-domain Routing -Shortest Path, Distance Vector Algorithms, Link State Routing, Inter-domain Routing Protocols.	
4.3	Congestion control algorithms: Open loop congestion control, Closed loop congestion control, QoS parameters.	
5	**Transport Layer**	**07**
5.1	The Transport Service: Transport service primitives, Berkeley Sockets, Connection management (Handshake), UDP, TCP, TCP state transition, TCP timers.	
5.2	TCP Flow control (sliding Window), TCP Congestion Control: Slow Start	

6	**Application layer**	**05**
6.1	Application layer Paradigms, Client-Server Paradigm: Application Programming Interface.	
6.2	Standard Client Server applications: World Web and HTTP, FTP, Electronic Mail, Domain Name System (DNS).	
Total		**39**

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

Computer Communication and Networking (Lab)

Lab Objectives:	
1	To study and understand basic network hardware components and network configurations using Linux and Windows platforms.
2	To simulate and analyze client-server communication using TCP and UDP protocols in NS-2 and NetSim environments.
3	To capture, inspect, and interpret network traffic using Wireshark and apply packet sniffing techniques for network analysis.
4	To configure and manage routing tables, IP forwarding, and firewalls (IPTables) on Linux and Windows operating systems.
5	To design, simulate, and evaluate wireless network technologies (WiMAX, ZigBee, Bluetooth) in NS-2, and compare their performance based on throughput, range, and power consumption.
6	To implement and analyze Wireless Sensor Networks (WSNs) using LEACH protocol in NS-2 with emphasis on energy efficiency, network lifetime, and packet delivery under varying network conditions.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Students will be able to identify key network hardware components and configure network settings using Linux and Windows tools.
2	Students will develop and simulate client-server communication models using TCP and UDP protocols in NS-2 and NetSim.
3	Students will demonstrate the ability to capture, analyze, and interpret network traffic using Wireshark and apply packet sniffing techniques.
4	Students will configure routing tables, manage IP forwarding, and set up firewalls using IPTables on both Linux and Windows platforms.
5	Students will simulate and evaluate the performance of wireless networks (WiMAX, ZigBee, Bluetooth) based on parameters like throughput, range, and power consumption.
6	Students will implement Wireless Sensor Networks using the LEACH protocol in NS-2 and analyze the impact of node density and clustering on energy consumption and network lifetime.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	To study network components.
2	To build a simple client-server model in NS-2, demonstrating TCP or UDP-based communication.
3	To study the working of wireshark, a packet sniffing tool, and analyze network traffic using sniffing technique.
4	To understand and implement socket programming using NetSim for communication between client and server.
5	To view, add, delete, and modify routing tables and configure IP forwarding using IP tables in Windows operating systems.
6	Use a tool (Eg. NS2) to implement a specific Network topology with respect to the given number of nodes and physical configuration and do: Graphical simulation of network with Routing Protocols and traffic consideration (TCP, UDP), Analysis of network performance for quality parameters such as packet-delivery-ratio, delay, and throughput
7	Set up and configuration of firewalls in Linux/windows (Use IP Tables)
8	To install and configure the WiMAX module in NS-2 and study how varying the symbol rate (low vs. high) affects throughput, latency, and packet loss.
9	Use basic networking commands in Linux (ping, tracert, nslookup, netstat, ARP, RARP,ip, ifconfig, dig, route, etc) and set up a network environment with multiple IP addresses and configuration of ARP tables. Set up a network environment in Windows platform also.
10	Working with routing in Linux: View the current routing table, Add and delete routes, Change default gateway Perform IP Tables for IP forwarding.
11	Configure and simulate either a Bluetooth or ZigBee network in NS-2. To compare key performance metrics (throughput, range, power consumption) with other wireless technologies (Wi-Fi, MANET). To examine how different topologies (star, mesh) and super frame structures (in ZigBee) influence network behavior.
12	To implement and analyze a Wireless Sensor Network using the LEACH protocol in NS-2. To study energy consumption, network lifetime, and packet delivery under various node densities and clustering scenarios. To explore the "new" wireless trace file format in NS-2 for gathering detailed WSN simulation metrics.

Software Testing and Quality Assurance								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECPE261	Software Testing and Quality Assurance (Theory)	03	---	---	03	---	---	03
26ECPE2L61	Software Testing and Quality Assurance (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Fundamentals of Programming, Software Engineering.	
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 modules, students will be able to:	
1	Investigate the reason for bugs and analyse 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

Module	Theory Course Contents	Hrs
1	**Testing Methodology**	**08**
1.1	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.	
1.2	Software Testing Terminology and Methodology: Software Testing Terminology, Software Testing Life Cycle (STLC), Software Testing methodology.	
1.3	Verification and Validation: Verification, Verification requirements, Validation.	
2	**Testing Techniques**	**09**
2.1	Black Box testing: boundary value analysis, equivalence class testing, state table-based testing, cause-effect graphing based testing, error guessing.	
2.2	White box Testing Techniques: need, logic coverage criteria, basis path testing, graph matrices, loop testing, data flow testing, mutation testing, Static Testing.	
2.3	Validation Activities: Unit validation, Integration, Function, System, Acceptance Testing.	
2.4	Regression Testing: Progressive vs. Regressive	
3	**Managing the Test Process**	**07**
3.1	Test Management: test organization, structure and of testing group, test planning, detailed test design and test specification.	
3.2	Software Metrics: need, definition and classification of software matrices.	
3.3	Efficient Test Suite Management: minimizing the test suite and its benefits	
4	**Test Automation**	**04**
4.1	Automation and Testing Tools: need, categorization, selection and cost in testing tool.	
4.2	Guidelines for testing tools.	
5	**Testing for specialized environment**	**05**
5.1	Agile Testing, Agile Testing Life Cycle, Challenges in Agile Testing.	
5.2	Testing Object-Oriented Software: OOT Basics, Object-oriented Testing.	
6	**Quality Management**	**06**
6.1	Software Quality Management, McCall's quality factors and Criteria	
Total		**39**

Textbooks:	
1	Software Testing Principles and Practices, Naresh Chauhan, Oxford Higher Education.
2	Software Testing and quality assurance theory and practice, Kshirasagar Naik, Priyadarshi Tripathy, Wiley Publication
3	Software Testing: Principles, Practices, Techniques, BPB Publications, Dr. Anand Nayyar
4	Software Testing: A Practical Approach, Sandeep Desai and Abhishek Srivastava PHI Learning
5	Principles of Software Testing. Srinivasan Desikan and Gopalaswamy Ramesh Pearson Education - South Asia Paperback Edition
Reference books:	
1	Effective Methods for Software Testing, Willam E. Perry, Wiley Publication, third edition.
2	Software Testing Concepts and Tools, Nageswara Rao Pusuluri, Dreamtech press.
3	The Art of Software Testing (3rd Edition), Glenford J. Myers, Corey Sandler, and Tom Badgett (Wiley)
4	Lessons Learned in Software Testing: A Context-Driven Approach. Cem Kaner, James Bach, and Bret Pettichord (Wiley)

Software Testing and Quality Assurance
(Lab)

Lab Prerequisite: Programming Language (C++, Java), Software Engineering.	
Lab Objectives:	
1	To understand the core principles, terminology, and lifecycle of software testing through practical implementation.
2	To analyze software systems for potential failures and apply verification and validation techniques.
3	To design and execute test cases using both black box (e.g., boundary value analysis) and white box (e.g., basis path testing) techniques.
4	To gain hands-on experience with test management tools like Qase and defect tracking tools like JIRA.
5	To automate test cases using modern tools such as Selenium and understand their integration in a real-time testing framework.
6	To apply software testing metrics and quality models to evaluate and enhance software product quality.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Demonstrate an understanding of different testing methodologies, software failures, and their causes through case study analysis.
2	Design effective test cases using black box and white box testing techniques and execute them manually.
3	Create and interpret control flow graphs for conducting basis path and loop testing.
4	Use tools such as Selenium, Qase, and JIRA for automating and managing the software testing process.
5	Analyze and report software defects, regression scenarios, and test coverage using appropriate metrics.
6	Apply agile testing techniques and quality models to ensure high-quality deliverables in agile environments.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	To study software testing fundamentals and analyze real-world software failure case studies.
2	Write a program for any one function of the selected system. Introspect the causes for its failure and write down the possible reasons for its failure.
3	Study the system, requirement specifications and designing the system.
4	To implement white box testing techniques like basis path testing and loop testing using control flow graphs.
5	Select the test cases (positive and negative scenarios) for the selected system.
6	Design Test cases for the system using boundary value analysis or equivalent class partitioning.
7	Manual execution of test cases and prepare defect reports.
8	Identify regression scenarios for automation for any one/two test case.
9	To identify and compute relevant software testing metrics such as defect density and code coverage.
10	To use a test automation tool (e.g., Selenium) for automating test cases on a web application.
11	Study of any test management tool (e.g. Qase).
12	Writing down test cases and execution using tools (e.g. Qase).
13	Study defect management (e.g. JIRA)
14	Design quality matrix for your system.
15	To perform agile testing practices and prepare test cases in an agile project environment.

Machine Learning

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE262	Machine Learning (Theory)	03	---	---	03	---	---	03
26ECPE2L62	Machine Learning (Theory)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Data Structures, Statistics for Engineers, Design and Analysis of Algorithms

Course Objectives:

1	Introduce core machine learning paradigms, workflows, and evaluation metrics.
2	Provide a mathematical foundation in linear algebra and matrix decompositions for ML.
3	Explain linear regression models, regularization, and Support Vector Machines.
4	Detail unsupervised clustering techniques and learning algorithms.
5	Explore artificial neural networks, multi-layer perceptrons, and logistic regression.
6	Examine dimensionality reduction techniques and feature extraction methods.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Evaluate machine learning model performance using standard validation metrics.
2	Apply linear algebra and matrix operations to solve machine learning problems.
3	Implement linear regression and Support Vector Machines for predictive modeling.
4	Analyze clustering algorithms and unsupervised learning approaches.
5	Design artificial neural network architectures and backpropagation algorithms.
6	Execute dimensionality reduction to address the curse of dimensionality.

Module	Theory Course Contents	Hrs
1	**Introduction to Machine Learning**	**06**
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	
2	**Mathematical Foundation for ML**	**09**
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.	
3	**Liner models**	**07**
3.1	The least-squares method, Multivariate Linear Regression, Regularised Regression, Using Least-Squares Regression for classification	
3.2	Introduction to SVM.	
4	**Clustering**	**04**
4.1	Hebbian Learning rule	
4.2	Expectation -Maximization algorithm for clustering	
5	**Classification models**	**12**
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.	
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	
6	**Dimensionality Reduction**	**06**
6.1	Curse of Dimensionality.	
6.2	Feature Selection and Feature Extraction	
6.3	Dimensionality Reduction Techniques, Principal Component Analysis.	
	Total	**39**

Textbooks:	
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.
Reference books:	
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.
4	Shai Shalev-Shwartz, Shai Ben-David, "Understanding Machine Learning", Cambridge University Press.
5	Peter Harrington, "Machine Learning in Action", DreamTech Press.

Machine Learning (Lab)

Lab Objectives:	
1	To provide hands-on experience in applying machine learning algorithms to real-world datasets.
2	To understand and implement key performance evaluation metrics for various ML models.
3	To develop skills in applying mathematical foundations such as vector operations and linear algebra in ML tasks.
4	To enable students to build, train, and evaluate supervised and unsupervised learning models.
5	To implement dimensionality reduction techniques to improve model performance and visualization.
6	To introduce neural network architectures and train basic models using perceptron and backpropagation algorithms.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Students will be able to build end-to-end machine learning models and analyze their performance.
2	Students will demonstrate the ability to apply appropriate evaluation metrics based on the problem context.
3	Students will apply mathematical concepts like eigen decomposition, vector norms, and SVD in ML tasks.
4	Students will be able to implement and differentiate between various classification, regression, and clustering algorithms.
5	Students will understand the challenges of high-dimensional data and apply PCA and feature selection techniques.
6	Students will design and implement neural networks for simple classification problems using perceptron and MLP.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	To understand and implement a basic machine learning pipeline using a standard dataset.
2	To demonstrate cross-validation and analyze overfitting and underfitting in machine learning models.
3	To evaluate the performance of classification models using confusion matrix and other performance metrics.
4	To perform vector operations and compute distances between vectors using Python.
5	To compute eigenvalues, eigenvectors, and perform Singular Value Decomposition (SVD) of a matrix.

6	To implement linear regression on a real-world dataset and interpret model coefficients.
7	To compare regularized regression techniques (Ridge and Lasso) and observe their effect on model performance.
8	To implement Support Vector Machine (SVM) for binary classification using different kernels.
9	To apply K-Means clustering algorithm and visualize cluster separation.
10	To implement Expectation-Maximization (EM) algorithm for Gaussian Mixture Models and analyze results.
11	To implement a single-layer perceptron for classifying linearly separable data.
12	To build and train a multi-layer perceptron using backpropagation algorithm.
13	To implement logistic regression for binary classification using a real-world dataset.
14	To apply Principal Component Analysis (PCA) for dimensionality reduction and data visualization.
15	To perform feature selection and analyze its impact on model performance.

Data Warehousing and Mining								
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE263	Data Warehousing and Mining (Theory)	03	---	---	03	---	---	03
26ECPE2L63	Data Warehousing and Mining (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite:
Data Structures, Database Management System, Design and Analysis of Algorithm.

Course Objectives:

1	Introduce core machine learning paradigms, workflows, and evaluation metrics.
2	Provide a mathematical foundation in linear algebra and matrix decompositions for ML.
3	Explain linear regression models, regularization, and Support Vector Machines.
4	Detail unsupervised clustering techniques and learning algorithms.
5	Explore artificial neural networks, multi-layer perceptrons, and logistic regression.
6	Examine dimensionality reduction techniques and feature extraction methods.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Evaluate machine learning model performance using standard validation metrics.
2	Apply linear algebra and matrix operations to solve machine learning problems.
3	Implement linear regression and Support Vector Machines for predictive modeling.
4	Analyze clustering algorithms and unsupervised learning approaches.
5	Design artificial neural network architectures and backpropagation algorithms.
6	Execute dimensionality reduction to address the curse of dimensionality.

Module	Theory Course Contents	Hrs
1	**Data Warehousing and Dimension Modelling**	**08**
1.1	Introduction to Data Warehouse, Characteristics of Data Warehouse	
1.2	Components of Data warehouse Architecture, Data warehouse architecture	
1.3	Data warehouses versus Data Marts.	
1.4	E-R Modelling versus Dimensional Modelling,	
1.5	Data Warehouse Schemas; Star Schema, Snowflake Schema, Fact Less Fact Table, Fact Constellation Schema.	
1.6	Inside Dimensional Table, Inside Fact Table.	
1.7	OLTP Systems versus OLAP.	
2	**ETL and OLAP**	**06**
2.1	Major steps in ETL process, Data Extraction Methods	
2.2	Data Transformation; Basic Tasks in Transformation, Major Data Transformation Types	
2.3	Data Loading Techniques.	
2.4	What is Multidimensional Data, OLAP Models: MOLAP, ROLAP.	
2.5	OLAP operations: Slice, Dice, Rollup, Drilldown and Pivot.	
3	**Data Mining and Data pre-processing**	**07**
3.1	Introduction to data mining, Architecture for Data Mining.	
3.2	KDD process, Data Mining Functionalities, Interestingness Measures.	
3.3	Classification of data mining system, major issues in data mining.	
3.4	Data Summarization, Data Cleaning, Data Integration and Transformation,	
3.5	Data Reduction, Data Discretization and Concept Hierarchy Generalization.	
4	**Mining frequent patterns and associations**	**05**
4.1	Market Basket Analysis, Frequent Item, Closed Item sets, & Association Rule	
4.2	Frequent Pattern Mining, Efficient and Scalable Frequent Item set Mining Methods: Apriori Algorithm.	
5	**Classification and Prediction**	**07**
5.1	Definition, Decision tree induction	
5.2	Bayesian classification	
5.3	Introduction to prediction, Linear and logistic regression techniques	
5.4	Accuracy and error measures.	
6	**Cluster analysis**	**06**
6.1	Definition, Distance Measures,	
6.2	Clustering Algorithms: Partitioning- K means and K-medoids	
	Total	**39**

Textbooks:	
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.
Reference books:	
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.

Useful Links:	
1	https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2	https://www.coursera.org/specializations/data-mining
3	https://www.udemy.com/course/data-mining-python/

Data Warehousing and Mining (Lab)

Lab Objectives: After successful completion of the lab course students will be able to:	
1	To design data warehouses and apply data processing, transformation, and visualization techniques using modern business intelligence tools.
2	To perform OLAP operations for efficient multidimensional data analysis and reporting.
3	To apply various classification techniques and algorithms (such as Random Forest and Naïve Bayes) for predictive data analysis.
4	To implement association rule mining and decision tree algorithms (such as Apriori and ID3) for pattern discovery and logical classification.
5	To develop predictive models using linear and multiple regression for analyzing relationships and making continuous estimations.
6	To implement unsupervised learning algorithms such as K-Means for effective data clustering and pattern segmentation.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Understand data transformation and visualization.
2	Perform OLAP operations for multidimensional data analysis.
3	Apply classification techniques.
4	Implement association and decision tree algorithms.
5	Develop predictive models using linear and multiple regression.
6	Perform clustering using K-Means algorithm.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	One case study on building Data warehouse/Data Mart • Write Detailed Problem statement and design dimensional modelling (creation of star and snowflake schema) • Implementation of all dimension table and fact table
2	To Perform Data Processing and Visualization using open-source tool like Power Bi / Tableau etc..
3	To perform data transformation and OLAP operations using open-source tool like Power Bi / Tableau etc...
4	To perform classification using the Random Forest algorithm using open-source tool (WEKA, R tool, XL Miner, Orange etc.)
5	To perform classification using the Naïve Bayes algorithm using open-source tool (WEKA, R tool, XL Miner, Orange etc.)
6	To implement the Apriori algorithm using open-source tool (WEKA, R tool, XL Miner, Orange etc.)
7	To implement the ID3 algorithm for decision tree learning using Python/Java.
8	To implement the Naïve Bayes classification algorithm using Python/Java.
9	To implement Linear Regression for predictive analysis using Python/Java
10	To implement Multiple Regression for predictive analysis using Python/Java
11	To implement the K-Means Clustering algorithm using Python/Java.
12	Demo on any cloud-based data warehousing process which gives a holistic view of Data Warehouse

Data sets available for download:	
1	Datasets for data mining "http://www.inf.ed.ac.uk/teaching/courses/dme/html/datasets0405.html"
2	Datasets for data mining "https://www.kdnuggets.com/datasets/index.html"
3	Datasets for data mining "https://www.kdnuggets.com/datasets/index.html"
4	Kaggle datasets
Term-Work:	
1	Term work should consist of 10 experiments.
2	The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
3	Total 25 Marks (Experiments: 15-marks, Term work Assessment: 10-marks)

Digital Image Processing									
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**				
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECPE361	Digital Image Processing (Theory)	03	---	---	03	---	---	03
26ECPE3L61	Digital Image Processing (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite: Digital Signal Processing

Course Objectives:

1	Introduce fundamental concepts of digital image processing, sensing, sampling, and color image models.
2	Explain spatial and frequency domain image enhancement techniques including filtering and histogram processing.
3	Detail orthogonal image transforms such as 2D DFT, Cosine, and Hadamard transforms.
4	Explore gradient/Laplacian edge detection and multi-resolution wavelet transform applications.
5	Examine image segmentation strategies, restoration models, and Wiener filtering techniques.
6	Analyze image compression models, spatial/temporal redundancy, and standard coding methods.

Course Outcomes:

After successful completion of the modules, students will be able to:

1	Understand image acquisition, sampling, quantization, and color model representations.
2	Apply spatial and frequency domain filters to enhance digital image quality.
3	Analyze images using 2D orthogonal and unitary transform techniques.
4	Implement edge detection algorithms and wavelet transforms for feature extraction and noise reduction.
5	Execute image segmentation algorithms and degradation-restoration models.
6	Evaluate image compression standards and coding techniques to reduce data redundancy.

Module	Theory Course Contents	Hrs
1	**Fundamentals of Digital Image Processing**	**04**
1.1	Introduction of image processing, Different types of images, Visual perception, Image sensing and Acquisition, Quantization, Sampling, color image processing, Revision of Mathematical concepts for image processing.	
2	**Enhancement in Spatial and Frequency domain**	**06**
2.1	Intensity transformation, Filtering in spatial and Frequency domain: Image negatives, Log transformations, Histogram processing, Spatial filter: smoothing and Sharpening, Discrete Fourier transform, properties of 2-D DFT, Image smoothing and Sharpening in Fourier domain.	
3	**Image transforms**	**05**
3.1	Two-dimensional orthogonal and Unitary transforms, Properties of Unitary transforms, 2D DFT, Cosine transforms, Hadamard transforms, Comparison of image transforms.	
4	**Edge Detection and Wavelet transform**	**10**
4.1	Gradient and Laplacian based edge detection, Diffusion based edge detection: Isotropic and anisotropic diffusion.	
4.2	Wavelet transform for Image Processing: Multi resolution expansion, Wavelet functions, Wavelet Series expansion, Discrete Wavelet transforms, Wavelet transforms for two-dimensional signals (images), Applications of wavelet transforms for edge extraction, noise suppression.	
5	**Image Segmentation and Restoration**	**09**
5.1	Thresholding, region-based Morphological Watersheds, Bayesian based image segmentation.	
5.2	Image restoration and reconstruction: Models of image degradation, noise models, Spatial and Frequency domain based approaches for image restoration, Wiener Filtering.	
6	**Image Compression**	**05**
6.1	Spatial and Temporal redundancy, Basic image compression models, compression standards, basic compression methods: Huffman coding, Run-length coding, Block transform coding, Predictive coding	
	Total	**39**

Textbooks:	
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 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.

Digital Image Processing (Lab)

Lab Objectives:	
1	Introduce digital image representation, basic matrix operations, and pixel transformations.
2	Implement spatial domain enhancements including histograms and intensity transformations.
3	Apply frequency domain filtering and 2D Fourier transforms for image analysis.
4	Investigate statistical properties, bit-plane slicing, and image interpolation methods.
5	Utilize spatial masks and gradient operators for edge detection and sharpening.
6	Explore advanced applications like morphological operations and transform-based compression.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Perform basic image operations and compute image negatives and contrast stretches.
2	Apply brightness adjustments, thresholding, and histogram processing.
3	Analyze images using 2D FFT and frequency-domain smoothing/sharpening filters.
4	Calculate statistical metrics, extract bit planes, and execute spatial interpolation.
5	Detect edges and sharpen images using derivative masks (Sobel, Prewitt, Roberts).
6	Implement morphological operations and DCT-based image compression techniques.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Simulation and Display of an Image, Negative of an Image (Binary & Gray Scale).
2	Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
3	Read an 8 bit image and then apply different image enhancement techniques: (a) Brightness improvement (b) Brightness reduction (c) Thresholding (d) Negative of an image (e) Log transformation (f) Power Law transformation.
4	Display of bit planes of an Image.
5	Computation of Mean, Standard Deviation, Correlation coefficient of the given Image.
6	Implement various Smoothing spatial filters. Write a program to implement various low pass filters and high pass filters in frequency domain.
7	Display of FFT (1-D & 2-D) of an image.
8	Implement and study the effect of Different Mask (Sobel, Prewitt and Roberts).
9	Implementation of image sharpening filters and Edge Detection using Gradient Filters.
10	Implement different interpolation techniques on image.
11	Implement Image compression using DCT Transform.
12	Write a program for erosion and dilation, opening & closing using inbuilt and without inbuilt function.

Micro Electro-Mechanical Systems

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE362	Micro Electro-Mechanical Systems (Theory)	03	---	---	03	---	---	03
26ECPE3L62	Micro Electro-Mechanical Systems (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Electronic Devices and Circuits,
Embedded Systems and RTOS

Course Objectives:

1	Introduce MEMS technology, microelectronics integration, and real-world applications in IoT and biomedical fields.
2	Examine the material properties and mechanical, thermal, and electrical characteristics of MEMS materials.
3	Explain different micro-sensing mechanisms and actuation principles used in MEMS devices.
4	Detail microfabrication processes including photolithography, deposition, etching, and wafer bonding.
5	Explore the construction, working principles, and fabrication steps of specific MEMS devices like cantilevers and accelerometers.
6	Analyze reliability issues, failure mechanisms, and failure rate curves associated with MEMS systems.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Identify MEMS applications and their role in modern systems such as automotive safety and IoT.
2	Evaluate material properties for selecting appropriate substrates and thin-film layers in MEMS design.
3	Analyze capacitive, piezoelectric, and electrostatic principles in MEMS sensors and actuators.
3	Describe cleanroom fabrication sequences including deposition, lithography, and etching techniques.
4	Explain the operational principles and fabrication flow of core MEMS devices like pressure sensors and micromirrors.
5	Assess reliability metrics and common failure mechanisms affecting MEMS device lifespan.
6	Identify MEMS applications and their role in modern systems such as automotive safety and IoT.

Module	Theory Course Contents	Hrs
1	**Introduction to MEMS**	**04**
1.1	Introduction to MEMS and Microelectronics Technologies.	
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.	
2	**MEMS Materials and Their Properties**	**07**
2.1	Use of Si, SiO_2, SiN, SiC, Cr, Au, Al, Ti, SU8, PMMA, Pt in building MEMS applications.	
2.2	Material properties such as Young modulus, Poisson's ratio, density, piezo resistive coefficients, TCR, Thermal Conductivity, Thermoelectricity.	
3	**MEMS Sensors and Actuators**	**07**
3.1	Types of MEMS Sensing (Capacitive, Piezoelectric, Piezo resistive).	
3.2	Micro Actuation principles: Electrothermal, Piezoelectric and Electrostatic.	
3.3	Micro Actuation tools: Micro Grippers, Micro Gears, Micro Motors, Micro Valves, Micro Pumps.	
4	**MEMS Fabrication Processes**	**09**
4.1	Understanding MEMS Processes & Process parameters for: Cleaning, Growth & Deposition, Ion Implantation & Diffusion, Annealing.	
4.2	Lithography:X-Ray Lithography, Photolithography, PVD,CVD,Wet etching, Dry etching, Plasma etching, DRIE, Etch Stop Techniques, Die, Wire & Wafer Bonding, Dicing, Packaging.	
5	**MEMS Devices**	**09**
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.	
6	**MEMS Reliability**	**03**
6.1	Reliability and various failure mechanisms for MEMS devices.	
6.2	Reliability curve.	
Total		**39**

Textbooks:	
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-Hill

Micro Electro-Mechanical Systems (Lab)

Lab Objectives:	
1	To simulate and analyze the mechanical and behavioral characteristics of cantilever-based MEMS devices.
2	To study and evaluate the performance profiles of specialized micro-actuators, including circular and spring-mass actuators.
3	To measure and investigate the thermal response of heated membranes under varying voltage excitations.
4	To analyze temperature variations of heated membranes subjected to standard and customized voltage profiles.
5	To study the differential thermal response and characteristics of micro-heaters.
6	To perform modeling, simulation, and case-based analysis of advanced and recent developments in MEMS technology.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Ability to simulate and interpret the mechanical characteristics of cantilever structures.
2	Competence in analyzing the functional behavior of circular and spring-mass actuators.
3	Capability to measure and correlate the thermal output of heated membranes with applied voltage.
4	Skill to assess membrane temperature dynamics under both standard and customized voltage inputs.
5	Understanding of differential thermal responses in micro-heater systems.
6	Proficiency in modeling MEMS devices and evaluating recent technological advancements through case studies.

Suggested Experiments: Students are required to complete at least 08 experiments.

Sr.No.	**Name of the Experiments**
1	Simulate and analyse the characteristics of Cantilever.
2	Simulate and analyse the characteristics of Circular actuator.
3	Simulate and analyse the characteristics of Spring mass actuator.
4	Measure the temperature of heated membrane for a given voltage excitation.
5	Study the temperature of heated membrane to standard voltage profile.
6	Study the temperature of heated membrane to customized voltage profile.
7	Study the differential response of micro heater.
8	Modeling and simulation of MEMS devices.
9	Case study on advance topic.
10	Case study of recent development in the subject.

Principles of Control System								
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE363	Principles of Control System (Theory)	03	---	---	03	---	---	03
26ECPE3L63	Principles of Control System (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Fundamentals of Engineering Mathematics-1, Fundamentals of Engineering Mathematics-2.

Course Objectives:

1	Introduce control system concepts, mathematical modeling, block diagrams, and signal flow graphs.
2	Analyze transient and steady-state time responses for first and second-order systems.
3	Examine time-domain stability using Routh-Hurwitz criteria and root locus techniques.
4	Detail frequency response analysis using Bode plots, polar plots, and Nyquist criteria.
5	Explore the design and tuning of classical PID controllers.
6	Outline state-space representations, state solutions, and system controllability/observability.

Course Outcomes:
After successful completion of the modules, students will be able to:

1	Derive mathematical models and transfer functions for physical control systems.
2	Evaluate time-domain transient specifications and steady-state error constants.
3	Determine system stability using Routh criteria and root locus plots.
4	Analyze frequency response performance and stability via Bode and Nyquist plots.
5	Design and tune P, PI, and PID controllers to meet performance requirements.
6	Formulate state-space models and assess system controllability and observability.

Module	Theory Course Contents	Hrs
1	**Introduction to the Control Systems**	**06**
1.1	Various Classification of Control System, Closed Loop Control Versus Open Loop Control, Feedback Characteristics: Types of feedback.	
1.2	Mathematical model of physical systems, transfer function.	
1.3	Block diagram and Signal Flow Graph (SFG) representation of control systems; Block diagram reductions; Mason's gain formula.	
2	**Time response analysis**	**07**
2.1	Standard test signals: Time response of 1st. order systems to unit step and unit ramp inputs. Time response of second order systems to unit step input. Time response specifications for second order system	
2.2	Application of initial and final value theorem; Steady state error and Error constants of different types of control systems	
3	**Stability analysis in time domain**	**07**
3.1	Concepts of stability: Necessary conditions of stability, Hurwitz stability criterion, Routh stability criterion, application of Routh stability criterion to linear feedback systems, Relative stability Analysis.	
3.2	Root locus techniques: Root locus concepts, rules for construction of root loci, determination of roots from root locus.	
4	**Frequency Response Analysis**	**07**
4.1	Introduction to frequency response; Polar plots, Bode plots, determination of stability from Bode plots, Performance specifications in frequency domain.	
4.2	Nyquist stability criterion, application of Nyquist stability criterion to linear feedback systems.	
5	**Introduction to Controllers**	**05**
5.1	Controllers: Introduction, Proportional, derivative and integral control actions, PD, PI and PID controllers and their applications to feedback control systems.	
5.2	Zeigler- Nichols method of tuning PID controllers for known dynamic models of the plant.	
6	**State-space Analysis**	**04**
6.1	Concept of state variables; State-space model; Canonical forms.	
6.2	Solution of state-space equation; Eigen-values and eigenvectors; Stability in state-space.	
6.3	Concept of controllability and observability.	
	Total	**39**

Textbooks:	
1	M. Gopal, "Control Systems: Principles and Design", 3rd edition, Tata McGraw Hill, 2008.
2	Richard Dorf, Robert Bishop, "Modern Control Systems", 11th edition, Pearson Education, 2008.
Reference books:	
1	Golnaraghi Farid, B. C. Kuo, "Automatic Control Systems", 10th edition, McGraw Hill, 2017
2	K. Ogata, "Modern Control Engineering", 6th edition, Prentice Hall, 2010.
3	I.J. Nagrath, M. Gopal, "Control System Engineering", New Age International, 2009
4	Norman Nise, "Control Systems Engineering", Wiley, 8th edition, 2019.

Principles of Control Systems (Lab)

Lab Objectives:	
1	Introduce simulation environments for modeling first and second-order control systems.
2	Analyze time-domain transient responses and steady-state error constants for various system types.
3	Investigate root locus techniques to study pole movements and system stability with varying gains.
4	Evaluate frequency-domain characteristics and stability using Bode and Nyquist plots.
5	Implement and tune classical P, PI, PD, and PID controllers to improve system performance.
6	Examine advanced system descriptions using state-space models, controllability, and observability tests.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Simulate differential equations and evaluate the time response of dynamical systems.
2	Calculate steady-state errors and performance metrics for type-0, 1, and 2 systems.
3	Construct root locus plots to analyze system stability and root trajectories.
4	Plot and interpret frequency response behaviors via Bode and Nyquist diagrams.
5	Design and tune PID controllers for effective closed-loop control.
6	Formulate state-space models and assess system controllability and observability.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	**Name of the Experiments**
1	To perform the time response of a first-order and second-order system to standard input signals.
2	To perform the frequency response of a second-order system to standard input signals
3	To solve a differential equation model using simulation software.
4	To perform the steady-state errors for type-0, 1 and 2 systems
5	To perform stability analysis of several control systems using Nyquist plots.
6	To perform controllability and observability of control systems.
7	To analyze the frequency response of first- and second-order systems using Bode plots
8	To introduce the P/PI/PD/PID controller and its tuning.
9	To plot the root locus of a given open-loop transfer function and analyze the movement of system poles with varying gain.
10	Model systems in state space form and evaluate responses.

IIoT and Industry 4.0

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECMM 61	IIoT and Industry 4.0 (Theory)	02	---	---	02	---	---	02
							Total Credits	02

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	--	--	100

Course Prerequisite: Web Technology, Internet of Things.	
Course Objectives:	
1	To introduce the foundational concepts and architecture of the Industrial Internet of Things (IIoT), highlighting its differences from traditional SCADA systems.
2	To explore core IIoT hardware components, including sensors, actuators, control systems, and industrial communication protocols (e.g., HART, MODBUS).
3	To analyze implementation and deployment challenges, focusing on system interoperability, security vulnerabilities, scalability, and legacy system integration.
4	To examine industrial communication protocols and architectures, comparing MQTT, MQTTS, and MODBUS alongside cloud/server requirements.
5	To understand control and supervisory automation levels, including PLCs, SCADA, HMIs, and their integration with MES and ERP systems.
6	To evaluate real-world IIoT applications and case studies, covering tank level monitoring, cloud integration (AWS, Azure), and predictive maintenance.
Course Outcomes: After successful completion of the modules, students will be able to:	
1	Understand the fundamental architecture, building blocks, and challenges of the Industrial Internet of Things in contrast to traditional SCADA systems.
2	Identify and interface various industrial sensors, actuators, and hardware components using standard communication protocols.
3	Analyze critical deployment challenges including system interoperability, cybersecurity risks, data privacy compliance, scalability, and legacy integration.
4	Evaluate communication protocols such as MODBUS, MQTT, and MQTTS alongside cloud architectural requirements for IIoT applications.

5	Explain the operational mechanisms of PLCs, SCADA, HMIs, and enterprise-level systems (ERP/MES) in industrial automation.
6	Examine real-world IIoT deployments through cloud integration, HMI-based monitoring, and predictive maintenance case studies.

Module	Theory Course Contents	Hrs
1	**Introduction & Architecture**	**03**
1.1	What is IIoT and the Connected world?	
1.2	SCADA Vs. IoT	
1.3	Architecture of IIoT	
1.4	IoT node, Challenges of IIoT	
2	**IIoT Components**	**05**
2.1	Fundamentals of Control System: Introduction, Components, Closed loop & Open loop system.	
2.2	Sensors and Interfacing: Introduction to Sensors, Classification, Role of Sensors in IIoT, Various types of Sensors, Special requirements for IIoT sensors.	
2.3	Role of Actuators, Types of Actuators.	
2.4	Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACnet, Current, M2M etc..	
3	**Implementation and Deployment Challenges in Industrial IoT**	**06**
3.1	Interoperability and Compatibility: Challenges in achieving seamless interoperability, Standardization issues across platforms, API integration and communication protocols	
3.2	Security Concerns: Common security vulnerabilities, Threat detection and mitigation strategies, Secure authentication and access controls	
3.3	Cybersecurity Risks: Emerging threats in the digital landscape, Role of encryption and secure data transmission, Risk assessment frameworks	
3.4	Data Privacy: Compliance with data protection regulations (e.g., GDPR, PDPB), Data anonymization and protection techniques, Ethical concerns in data handling	
3.5	System Scalability: Vertical vs. horizontal scaling strategies, Cloud vs. on premise scalability considerations, Resource optimization techniques	
3.6	Legacy Systems Integration: Challenges in modernizing legacy systems, Hybrid approaches for smooth transition, Cost vs. benefit analysis of upgrading vs. replacing.	
4	**Communication Protocols**	**04**
4.1	Importance of using MODBUS in IIOT Applications.	
4.2	MQTT vs. MQTTS .	
4.3	Cloud / Server architectural requirements for IIOT Applications.	

5	**Control & Supervisory Level of Automation**	**04**
5.1	Programmable logic controller (PLC)	
5.2	Control signal introduction, Digital I/O, Analog I/O, 4-20mA systems	
5.3	Supervisory Control & Data Acquisition (SCADA)	
5.4	Need of Human machine Interface (HMI) in Automation	
5.5	Basics of Enterprise Resource Planning (ERP) System & Manufacturing Execution System (MES)	
6	**Applications of IIOT**	**04**
6.1	Case study of Chemical Tank Level Monitoring application through HMI	
6.2	Case study on IIOT cloud integration with Microsoft Azure, AWS & other cloud services like Ubidots or Thingspeak,	
6.3	Case study on AWS Industrial IoT Predictive Maintenance	
	Total	**26**

Textbooks:	
1	Introduction to Industrial Internet of Things and Industry 4.0, 1st Edition, Sudip Misra, CRC Press.
2	Practical Industrial Internet of Things Security: A practitioner's guide to securing connected Industries, Sravani Bhattacharjee.
3	Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications, by Daniel Minoli, Bernd Scholz-Reiter, Florian, Willy Publication.
4	Architecting the Internet of Things, by Florian Michahelles, Springer, 2011.
Reference books:	
1	The Internet of Things in the Industrial Sector, Mahmood, Zaigham (Ed.), Springer Publication.
2	Industrial Internet of Things: Cyber manufacturing System, Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat , Springer Publication.
3	Industrial IoT Challenges, Design Principles, Applications, and Security by Ismail Butun (Editor), Springer Publications.

Useful additional resources:	
1	https://aws.amazon.com/iot/solutions/industrial-iot/
2	Security of the Internet of Things:Vulnerabilities, Attacks and Countermeasures by Ismail Butun, Member, IEEE, Patrik Osterberg, ¨Member, IEEE, and Houbing Song, Senior Member, IEEE.

ASIC FLOW DESIGN (LAB)

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tut	Total
26ECVSEL 61	ASIC Flow Design (Lab)	---	02	---	---	01	---	01

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
26EC VSEL 61	ASIC Flow Design (Lab)	---	---	---	25	25	50

Course Prerequisites: Basic Course on Digital Circuits (typically taught in the first/second year of UG Program)	
Lab Objectives:	
1	Familiarize students with the digital ASIC design flow and Linux-based EDA tool environments.
2	Train students in RTL design, Verilog coding, and testbench-based verification.
3	Introduce RTL synthesis and TCL scripting for hardware optimization.
4	Explore physical design steps including floorplanning, power planning, and placement.
5	Execute clock tree synthesis, static timing analysis, routing, and physical verification (DRC/LVS).
6	Guide students through post-route simulations, power analysis, GDSII export, and a comprehensive miniproject implementation.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Navigate Linux environments and execute standard ASIC design workflows.
2	Develop synthesizable Verilog RTL codes and verify functionality using testbenches.
3	Perform logic synthesis and write TCL scripts to automate design tasks.
4	Implement core physical design stages like floorplanning, power planning, and standard cell placement.
5	Analyze timing reports, perform clock tree synthesis, and clear design rule checks (DRC/LVS).
6	Execute post-route simulations, power analysis, and successfully complete an end-to-end miniproject.

Suggested Experiments:	
Sr.No.	**Name of the Experiments**
1	Overview of Digital ASIC Design Flow, Introduction to LINUX.
2	RTL Coding in Verilog, Simulation.
3	Test Bench Design , Verification and Testing.
4	RTL Synthesis, Introduction to TCL, TCL Scripting for synthesis.
5	Start of Physical Design: Import, Floorplan, IO fillers, and Power plan.
6	Logical Equivalence Checking , post synthesis simulations.
7	Placement, Clock Tree Synthesis and STA.
8	Routing, std. cell fillers, Block level DRC, Dummy Fill, Chip level DRC, Antenna DRC and LVS etc ECO post route.
9	Post Route netlist simulations, Power Analysis.
10	Export GDS, Miniproject Specification.
11	Miniproject Implementation.

References:	
1	Link: http://www.vlsi-expert.com/p/static-timing-analysis.html
2	https://c2s.gov.in/Completed_Training.jsp
3	RTL to GDS CVN REDDY SEELAM
4	Link: https://archive.nptel.ac.in/courses/106/105/106105161/
5	Link: https://www.udemy.com/course/vlsi-academy-sta-checks/
6	Link: https://www.udemy.com/course/vlsi-academy-physical-design-flow/
7	Link: https://www.youtube.com/c/Vlsi-expert/playlists
8	Link: https://www.vlsisystemdesign.com/inception-content-vsd/
9	Book for STA: Static Timing Analysis for Nanometer Designs: A Practical Approach by Jayaram Bhasker and Rakesh Chadha
10	Book: Advanced ASIC Chip Synthesis Using Synopsys Tools by Himanshu Bhatnagar
11	Book: Constraining Designs for Synthesis and Timing Analysis: A Practical Guide to Synopsys Design by Sridhar Gangadharan & Sanjay Churiwala
12	Book: Physical design essentials: an ASIC design implementation perspective by Khosrow Golshan
13	Book: Algorithms for VLSI Physical Design Automation by Sherwani, N. A.

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECCP161	Capstone Project – I	---	4#	---	---	02	---	02

 # indicate workload of learner not faculty

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
26ECCP161	Capstone Project – I	---	---	---	50	50	100

Capstone Project – I: Objectives	
1	To guide students in identifying authentic, impactful engineering or research problems stemming from societal and industrial needs.
2	To foster technical competence in designing, implementing, and validating problem solutions through experimentation, simulation, or theoretical modeling.
3	To instill a strong sense of social and environmental responsibility by evaluating project outcomes against sustainable development goals and standard engineering practices.
4	To cultivate collaborative teamwork and leadership abilities, enabling students to function effectively in multidisciplinary groups.
5	To introduce foundational project management principles, equipping students to manage resources, schedules, and workflows efficiently throughout project execution.
6	To enhance professional communication skills and cultivate a mindset of self-directed, life-long learning through comprehensive project documentation and technical presentations.
Capstone Project – I: Outcomes	
1	Identify and Formulate Problem Statements Description: Identify meaningful engineering problems based on societal, industrial, or research needs, and establish a structured scope for project execution.
2	Implement Technical Solutions and Analyze Results

	Description: Apply domain-specific knowledge and technical skills to develop solutions through theoretical analysis, experimentation, or simulations, and draw proper inferences from available results.
3	Evaluate Societal, Environmental, and Sustainable Impacts Description: Analyze the broader implications of engineering solutions within societal and environmental contexts, ensuring adherence to standard norms of sustainable development and engineering practices.
4	Demonstrate Leadership and Team Collaboration Description: Work effectively as an individual, a team member, or a leader within a diverse group, displaying strong interpersonal skills and collaborative dynamics.
5	Apply Project Management Principles Description: Demonstrate fundamental project management and planning principles to manage timelines, resources, and execution workflows during project work.
6	Communicate Effectively and Practice Life-Long Learning Description: Excel in written and oral technical communication through effective documentation and presentations, while demonstrating capabilities for self-directed learning that foster life-long learning.

Capstone Project-1: Group formation and planning guidelines	
1	Students should form groups with minimum 2(two) and not more than 4 (four)
2	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.
3	Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of the project.

Log book	
1	A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
2	Faculty supervisor may give inputs to students during major project activity; however, focus shall be on self-learning.
3	Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
4	Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
5	The solution to be validated with proper justification and report to be compiled in standard format.
6	With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Projects.

Assessment Objectives (for the mentors/evaluator)

1. To evaluate the student's ability to identify complex, real-world engineering or societal problems.
2. To assess depth of literature review and understanding of existing technological gaps.
3. To check preliminary design architecture, methodology selection, and project planning (milestones, resource allocation).

Continuous Internal Evaluation for Termwork

Breakdown (Total: 50 Marks)

Evaluation Component	Description & Focus	Marks Allocated
Problem Formulation & Scope	Clarity of problem statement, relevance to industry/society (UN SDGs), and definition of objectives.	10 Marks
Literature Survey & State-of-the-Art	Depth of research papers, patents, or existing commercial products analyzed; identification of research gaps.	10 Marks
Methodology & System Design	Feasibility study (technical, economic), block diagrams, mathematical modeling, algorithm design, or hardware/software architecture.	15 Marks
Project Diary & Punctuality (Log book)	Regular interaction with project guide, logbook maintenance, active team contribution, and milestone tracking.	5 Marks
Mid/End-Sem Presentation & Report	Interim report draft and presentation evaluated by a departmental panel.	10 Marks

Guidelines for Assessment of Project-I Practical/Oral Examination:

(50 Marks)

Project Report should be prepared as per the guidelines issued by the department. The report should cover the individual evaluation components given in the table below where ever applicable.

Evaluation Component	**Specific Assessment Criteria**	**Marks**
Live System / Prototype Demonstration	• Functional execution of the software/hardware model • Real-time performance, stability, and handling of test cases • Accuracy of results compared to stated objectives	15
Technical Depth & Core Concept Clarity	• Sound understanding of underlying algorithms, formulas, or design principles • Justification of chosen technology stack, tools, or methodologies • Ability to explain the architecture and workflow of the project	10
Code / Artifact Walkthrough & Debugging	• Cleanliness, modularity, and documentation of code or engineering drawings • Capability to explain specific lines of code or hardware schematics on the spot • Success in modifying parameters or troubleshooting a minor injected error during the session	10
Individual Contribution & Accountability	• Clarity on the student's specific role and ownership within the team • Depth of individual knowledge regarding the whole project, not just their assigned module • Peer collaboration and individual contribution log validation	08
Comprehensive Viva-Voce (Defense and Q&A)	• Confidence, clarity, and articulation during the questioning session • Ability to handle cross-questions from the external/internal panel effectively • Awareness of project limitations, future scope, and societal/industry relevance	07

Department of
Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-VII
A.Y. 2026-27

Course Type	Semester VII Teaching Scheme (AY 2026-27)								
	Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
			TH	PR	TUT	TH	PR	TUT	Total
PCC	26ECPC71/ 26ECPCL71	Power Electronics & Applications	3	2	---	3	1	---	4
PCC	26ECPC72/ 26ECPCL72	Deep learning & GenAI	3	2	---	3	1	---	4
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 4	3	2	---	3	1	---	4
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 5	3	2	---	3	1	---	4
RM	26ECRM71	Research Methodology	---	---	---	---	---	---	4¥
PROJECT	26ECCP271	Capstone Project-II	---	4	---	---	2	---	2
	Total Credits								22

¥ - Students are required to complete a 12 weeks MOOC course on research methodology.

Course Type	Semester VII Marks Scheme							
	Course Code	Course Name	TH	MT	CA	TW	PR/ OR	Total
PCC	26ECPC71/ 26ECPCL71	Power Electronics & Applications	60	20	20	25	25	150
PCC	26ECPC72/ 26ECPCL72	Deep learning & GenAI	60	20	20	25	25	150
PEC	26ECPE47X/ 26ECPE4L7X	Program Elective 4	60	20	20	25	25	150
PEC	26ECPE57X/ 26ECPE5L7X	Program Elective 5	60	20	20	25	25	150
RM	26ECRM71	Research Methodology	---	---	100	---	---	100¥
Project	26ECCP271	Capstone Project-II	---	---	---	50	100	150
	Total Marks							800

Program Electives (PEC 4)	Program Electives (PEC 5)
26ECPE471: Robotics	**26ECPE571:** Cloud Computing and GPU
26ECPE472: Electric Vehicles	**26ECPE572:** Cyber Security
26ECPE473: Wireless Technology	**26ECPE573:** Blockchain Technology

Power Electronics and Applications								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECPC71	Power Electronics and applications (Theory)	03	---	---	03	---	---	03
26ECPCL71	Power Electronics and applications (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Objectives:	
1	To understand the operating principles, characteristics, and comparison of various power semiconductor devices (SCR, TRIAC, DIAC, GTO, MOSFET, and IGBT).
2	To analyze the triggering methods, firing circuits, commutation techniques, and protection schemes for thyristors.
3	To study and evaluate the performance of uncontrolled and controlled single-phase AC-DC converters (rectifiers) with R and RL loads, including the effects of source and load inductances.
4	To examine the operation and analysis of DC-DC converters (Buck, Boost, and Buck-Boost) operating with various load types.
5	To explore the principles, performance parameters, and voltage control techniques of DC-AC (inverters) and AC-AC converters.
6	To investigate real-world industrial applications of power electronics, including renewable energy systems (solar/wind), VFDs, SMPS, UPS, grid integration, and power quality improvement.
Course Outcomes:	
1	Analyze the operational characteristics and switching behavior of power semiconductor devices to select suitable components for power converters.
2	Design reliable triggering, commutation, and protection circuits for thyristor-based power systems.
3	Evaluate the performance, voltage waveforms, and power factor of single-phase uncontrolled and controlled AC-DC converters with diverse loads.

4	Examine the steady-state operation and design of DC-DC switch-mode converters (Buck, Boost, and Buck-Boost) for efficient DC conversion.
5	Assess the operational principles, performance parameters, and voltage control techniques of single-phase DC-AC inverters and AC-AC converters.
6	Apply power electronics converters to modern systems including renewable energy integration, Variable Frequency Drives (VFDs), UPS, and power quality improvement.

Module	Theory Course Contents	Hrs
1	**Power Semiconductor Devices, Triggering, Commutation and Protection**	**08**
1.1	Operating principles, characteristics, and comparisons of power devices (SCR, TRIAC, DIAC, GTO, MOSFET, and IGBT).	
1.2	Thyristor turn-on methods, firing circuits for SCRs and TRIACs, and commutation techniques.	
1.3	Protection methods for thyristor-based systems.	
2	**AC-DC Converters**	**06**
2.1	Analysis of uncontrolled half-wave and full-wave rectifiers with R and RL loads.	
2.2	SCR-controlled single-phase rectifiers, power factor calculations, and the impact of source and load inductances.	
3	**DC-DC Converters**	**06**
3.1	Principles and steady-state analysis of Buck, Boost, and Buck-Boost DC-DC converter topologies.	
3.2	Operation and performance characteristics of DC-DC converters feeding R and RL loads.	
4	**DC-AC Converters**	**06**
4.1	Principle of operation and performance parameters.(Single Phase)	
4.2	Voltage control of single phase inverters	
5	**AC-AC Converters**	**06**
5.1	Principle of on-off and phase angle control; performance parameters.	
5.2	Single phase full-wave AC-AC converter with R and RL load.	
6	**Applications of Power Electronics**	**07**
6.1	Grid Integration, Solar and Wind Inverters.	
6.2	Variable Frequency Drives (VFDs)	
6.3	Switch-Mode Power Supplies (SMPS), and Uninterruptible Power Supplies (UPS)	
6.4	Power Quality Improvement	
	Total	**39**

Textbooks:	
1	P.S. Bhimbra, Power Electronics, Khanna Publishers, 2012.
2	M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education India, 2009
3	N. Mohan, T. M. Undeland, W. P. Robbins, Power Electronics: Converters Application and Design, John Wiley & Sons, USA, 2003.
4	M.D. Singh and K.B. Khanchandani, Power Electronics, Tata McGraw Hill
5	Power Electronics Systems: Theory and Design, J. P. Agrawal,Pearson Education
Reference books:	
1	P.C. Sen, Modern Power Electronics, Wheeler publications.
2	Ramamurthy, Thyristor & Their Applications
3	S. Shrivastava, Power Electronics, Nandu publications, Mumbai.

Power Electronics and Applications (Lab)

Lab Objectives:	
1	To experimentally plot and analyze the V-I characteristics, switching behavior, and operational differences of various power semiconductor devices, including SCR, TRIAC, DIAC, MOSFET, and IGBT.
2	To design, construct, and test various thyristor triggering networks (R, RC), forced commutation techniques, and protective circuit schemes.
3	To set up and evaluate the performance metrics (such as ripple factor, efficiency, and average/RMS output values) of single-phase uncontrolled and controlled rectifiers with resistive, inductive, and freewheeling diode configurations.
4	To build, test, and measure the voltage regulation and operational states (Continuous and Discontinuous Conduction Modes) of Buck, Boost, and Buck-Boost DC-DC switch-mode converters.
5	To construct and examine the output waveforms, frequency control, and voltage regulation of single-phase DC-AC inverters and AC-AC power conversion circuits.
6	To investigate and implement practical laboratory models or simulations of real-world power electronic applications, such as Switched-Mode Power Supplies (SMPS), Variable Frequency Drives (VFDs), or renewable energy integration setups.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Ability to interpret static V-I characteristics, switching behaviors, and operational boundaries of diverse power semiconductor switches (SCR, TRIAC, DIAC, MOSFET, and IGBT).
2	Proficiency in designing reliable gate-triggering networks, executing forced commutation techniques, and applying appropriate device protection schemes for thyristors.
3	Capability to analyze and evaluate the performance metrics of single-phase uncontrolled and controlled rectifiers under varying resistive, inductive, and freewheeling diode configurations.
4	Skill in operating and measuring voltage regulation, ripple characteristics, and operational modes (continuous and discontinuous) of Buck, Boost, and Buck-Boost DC-DC switch-mode converters.
5	Competence in constructing and examining output waveforms, frequency control, and voltage regulation strategies for single-phase DC-AC inverters and AC-AC power conversion circuits.
6	Practical readiness to apply power electronic principles to real-world industrial systems and renewable energy integration setups, such as SMPS and VFDs.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	To study V-I characteristics of SCR.
2	To study V-I characteristics of DIAC
3	To study V-I characteristics of TRIAC
4	To study triggering circuits for SCR : R Triggering circuit
5	To study triggering circuits for SCR : RC Triggering circuit
6	To study class B commutation circuit of SCR.
7	To study Half wave controlled rectifiers using SCR.
8	To study AC phase control circuits using DIAC and TRIAC.
9	To study uncontrolled rectifiers.
10	To study controlled rectifiers.
11	To Study a controlled rectifier with (i) Source Inductance (ii) Freewheeling diode.
12	To study buck and boost converters.
13	To study single phase DC to AC converters
14	To study AC to AC converters.

<table>
<tr><th colspan="9">Deep Learning and GenAI</th></tr>
<tr><th rowspan="2">Course Code</th><th rowspan="2">Course Name</th><th colspan="3">Teaching Scheme
(Hours per week)</th><th colspan="4">Credits Assigned</th></tr>
<tr><th>TH</th><th>PR</th><th>Tut</th><th>TH</th><th>PR</th><th>Tut</th><th>Total</th></tr>
<tr><td>26ECPC72</td><td>Deep Learning and GenAI (Theory)</td><td>03</td><td>---</td><td>---</td><td>03</td><td>---</td><td>---</td><td>03</td></tr>
<tr><td>26ECPCL72</td><td>Deep Learning and GenAI (Lab)</td><td>---</td><td>02</td><td>---</td><td>---</td><td>01</td><td>---</td><td>01</td></tr>
<tr><td colspan="8" align="right">Total Credits</td><td>04</td></tr>
</table>

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite: Basic Mathematics, Linear Algebra, Machine Learning

Course Objectives:

1	Introduce neural network foundations, deep feedforward training, activation functions, and optimization algorithms.
2	Examine Convolutional Neural Networks (CNNs), backpropagation mechanics, and modern vision architectures.
3	Analyze Recurrent Neural Networks (RNNs), sequence learning, and gating mechanisms like LSTM and GRU.
4	Explore unsupervised learning via various autoencoder variants and regularization techniques.
5	Understand Generative AI concepts, taxonomies, foundational generative models, and NLP text representations.
6	Investigate transformer architectures, attention mechanisms, vector databases, and GenAI ecosystem tools.

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

1	Explain perceptrons, loss functions, and optimization algorithms for deep networks.
2	Design and train CNNs using standard vision architectures.
3	Implement sequential models using RNNs, LSTMs, and GRUs.
4	Construct autoencoders for unsupervised representation learning.
5	Differentiate generative models and evaluate foundational NLP embeddings.
6	Build transformer-based systems utilizing self-attention and vector databases.

Module	Theory Course Contents	Hrs
1	**Introduction**	**06**
1.1	Biological neuron, Mc-Culloch Pitts Neuron, Perceptron, Perceptron Learning,	
1.2	**Training, Optimization and Regularization of Deep Neural Network**	
1.3	**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 6	
1.4	**Optimization** Learning with backpropagation, Learning Parameters: Gradient Descent (GD), Stochastic and Mini Batch GD, Momentum Based GD, Nesterov Accelerated GD, AdaGrad, Adam, RMSProp	
2	**Convolutional Neural Networks (CNN): Supervised Learning**	**08**
2.1	Convolution Operation, Motivation, Basic structure of a convolutional neural network: Padding, strides, pooling, fully connected layers, interleaving between layers.	
2.2	Training a convolutional network: Backpropagation through convolution, Backpropagation as convolution with inverted filter, Convolution/backpropagation as matrix multiplication	
2.3	Modern Deep Learning Architectures: LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet	
3	**Recurrent Neural Networks (RNN)**	**07**
3.1	Sequence Learning Problem, Unfolding Computational graphs, Recurrent Neural Network, Bidirectional RNN, Back propagation Through Time (BTT), Vanishing and Exploding Gradients, Truncated BTT	
3.2	Long Short Term Memory: Selective Read, Selective write, Selective Forget, Gated Recurrent Unit	
4	**Autoencoders: Unsupervised Learning**	**07**
4.1	Introduction, Linear Autoencoder, Undercomplete Autoencoder, Overcomplete Autoencoders, Regularization in Autoencoder	
4.2	Denoising Autoencoders, Sparse Autoencoders, Contractive Autoencoders	

5	**Introduction to GEN AI**	**06**
5.1	Introduction to Generative AI: Definitions, Generative AI vs. Discriminative AI, motivation and need for generative models History and evolution of Generative AI: GANs → Transformers → ChatGPT	
5.2	Mathematical foundations: Probability concepts and latent space representation Taxonomy of generative models: Explicit vs. Implicit models, Deterministic vs. Probabilistic models	
5.3	Foundation technologies for Generative AI: Autoencoders (AE), Variational Autoencoders (VAE), Architecture of Generative Adversarial Network (GAN)s, Transformers, Diffusion Models NLP foundations: Tokenization (WordPiece, BPE), text representation (Bag-of-Words, TF-IDF), word embeddings (Word2Vec, GloVe, BERT)	
6	**Transformer Foundations**	**05**
6.1	Transformer architecture: Attention mechanism, Scaled Dot-Product Attention, Self-attention, Multi-head Attention, Positional Encoding, Layer Normalization, Encoder (BERT) vs. Decoder (GPT) architectures	
6.2	Vector embeddings and Vector Databases: FAISS, Pinecone, Weaviate, Approximate Nearest Neighbor (ANN) search Generative AI ecosystem and tools: Hugging Face, LangChain, Diffusers, OpenAI APIs, GPT-4, DALL·E, Claude, Gemini, MusicLM	
6.3	Challenges and ethical concerns: Hallucination, bias, deepfakes, misuse, alignment, evaluation, multimodality, scaling, current challenges and future trends in Generative AI	
	Total	**39**

Textbooks:	
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.
6	Rehmani, Altaf. Generative AI for Everyone: Understanding the Essentials and Applications of This Breakthrough Technology. 2024.
7	Applied Generative AI for Beginners: Practical Knowledge on Diffusion Models,ChatGPT, and Other LLMs by Akshay Kulkarni, Adarsha Shivananda, Anoosh Kulkarni and Dilip Gudivada

Reference books:	
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.
6	Generative AI for Everyone: Deep learning, NLP, and LLMs for creative and practical applications - Karthikeyan Sabesan, Sivagamisundari, Nilip Dutta

Online References:	
Sr. No.	**Website Links**
1	https://nptel.ac.https://deeplearning.cs.cmu.edu/S21/index.html
2	http://www.cse.iitm.ac.in/~miteshk/CS6910.html
3	https://nptel.ac.in/courses/106/106/106106184/
4	https://www.deeplearningbook.org/
5	http://introtodeeplearning.com/
6	http://vlabs.iitb.ac.in/vlabs-dev/labs/machine_learning/labs/index.php

Deep Learning and GenAI (Lab)

Course Objectives	
1	Implement McCulloch-Pitts, Perceptron, and MLP models using deep learning libraries.
2	Apply gradient descent optimization algorithms to train neural networks.
3	Design and train deep feedforward neural networks for classification tasks.
4	Construct Convolutional Neural Network (CNN) architectures for image classification.
5	Build autoencoder models for image compression and denoising.
6	Implement sequential models and explore Generative AI and Hugging Face frameworks.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Simulate binary logic functions using perceptron algorithms in Python.
2	Evaluate and implement various gradient descent optimization techniques.
3	Develop and train deep neural networks with suitable loss and activation functions.
4	Design CNN models to process and classify visual data.
5	Construct autoencoders for feature extraction and data reconstruction.
6	Deploy sequential models and utilize pre-trained Generative AI tools.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1	**Based on Module 1 (Any ONE) 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	**Module 2 (Any ONE)**
	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 Adam Learning GD
3	**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
4	**Module 4 (Any One)**
	Design and implement a CNN model for digit recognition application.
	Design and implement a CNN model for image classification.
5	**Module 5 (Any One)**
	Design the architecture and implement the auto-encoder model for Image Compression.
	Design the architecture and implement the auto-encoder model for Image denoising.
6	**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.
7	**Module 7 (Any Two)**
	Explore generative AI frameworks (OpenAI, Gemini, Copilot) – OpenAI ChatGPT, Google Gemini, GitHub Copilot
	Generate simple text using a pre-trained model – Hugging Face Transformers, Google Colab
	Real-world applications: Healthcare, media, art, code generation, synthetic data generation

Robotics

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE471	Robotics (Theory)	03	---	---	03	---	---	03
26ECPE4L71	Robotics (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Applied Mathematics I , Applied Mathematics II.

Course Objectives:

1	Introduce robot classifications, components, specifications, and workspace coordinates.
2	Examine direct kinematics, rotations, homogeneous coordinates, and arm equations.
3	Analyze inverse kinematics solutions and workspace characteristics of multi-axis robots.
4	Explore trajectory planning methods, including joint-space, pick-and-place, and continuous path motion.
5	Understand task planning, configuration spaces, motion planning, and bug navigation algorithms.
6	Investigate robot vision principles, image processing, segmentation, and shape analysis.

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

1	Explain robot components, coordinate frames, and application specifications.
2	Compute direct kinematics and link coordinate transformations for robotic arms.
3	Solve inverse kinematics and analyze workspaces for multi-axis robot systems.
4	Design joint-space and operational-space motion trajectories for robotic tasks.
5	Implement task-level programming and collision-free path planning algorithms.
6	Apply computer vision techniques for image representation and object analysis in robotics.

Module	Theory Course Contents	Hrs
1	**Fundamentals of Robotics**	**04**
1.1	Robot Classification, Robot Components, Robot Specification, Joints, Coordinates, Coordinate frames, Workspace, Specification Notations, Applications.	
2	**Direct Kinematics**	**07**
2.1	Dot and Cross Products, Co-ordinate frames, Rotations, Homogeneous Co-ordinates, Link Co-ordinates, Arm Equation (3 axis and 4 axis Robots)	
3	**Inverse Kinematics and Work Space Analysis**	**08**
3.1	General properties of solutions, Tool Configuration, Inverse kinematics of 2 axis, 3 axis Robots, Work Space Analysis of 2 axis and 3 axis Robots, Work Envelope.	
4	**Trajectory planning**	**06**
4.1	Basics of Trajectory planning, Joint-space trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion	
5	**Task Planning**	**07**
5.1	Task level programming, Uncertainty, Configuration Space, Gross motion Planning; Grasp planning, Fine-motion Planning, Source and goal scenes, BUG 1, BUG 2 and Tangent Bug Algorithms	
6	**Robot Vision**	**07**
6.1	Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.	
Total		**39**

Textbooks:	
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
3	Robotics and Control, R.K. Mittal and I.J. Nagrath, McGraw Hill Education
Reference books:	
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 ",Wiely Publication
3	Modern Robotics: Mechanics, Planning, and Control, Kevin M. Lynch and Frank C. Park, Cambridge University Press

ROBOTICS (LAB)

Lab Objectives:	
1	Analyze the physical components, specifications, and operations of a 4-axis robotic arm.
2	Compute forward and inverse kinematics to determine spatial positions and joint angles for multi-axis robots.
3	Design and evaluate joint-space and Cartesian-space trajectories for smooth robotic motion.
4	Implement workspace analysis to map and visualize the functional work envelope of a robotic manipulator.
5	Apply computer vision algorithms for template matching and iterative image enhancement.
6	Execute image segmentation and shape analysis techniques for object recognition in robotics.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Demonstrate working knowledge of 4-axis robotic arm hardware, joints, and operational parameters.
2	Derive and simulate forward kinematics and inverse kinematics equations using transformation matrices.
3	Generate efficient joint-space and Cartesian-space motion profiles for pick-and-place and straight-line tasks.
4	Evaluate workspace limits and reachability envelopes for robotic arm configurations.
5	Develop template matching and iterative image processing pipelines for visual data.
6	Perform image segmentation to isolate and analyze the shapes of target objects for robotic tasks.

Suggested Experiments: Students are required to complete at least 08 experiments.	
Sr.No.	**Name of the Experiments**
1	Study and Demonstration of a Robotic Arm: Conduct a comprehensive study and hands-on demonstration of a 4-axis robotic arm to understand its physical components, joint configurations, and operational specifications.
2	Workspace Analysis: Perform a detailed workspace analysis for a multi-axis robotic manipulator to define and visualize its maximum reach and functional work envelope.
3	Forward Kinematics Implementation: Derive and implement the forward (direct) kinematics equations using homogeneous transformation matrices to determine the exact position and orientation of the end-effector.
4	Inverse Kinematics Simulation: Calculate and simulate the inverse kinematics solutions for a 2-axis or 3-axis robot to find the necessary joint angles required to reach a specific target coordinate.
5	Joint-Space Trajectory Planning: Design and execute a joint-space trajectory planning algorithm to enable smooth and coordinated movements for simulated pick-and-place operations.
6	Cartesian-Space Trajectory Planning: Develop a Cartesian-space trajectory plan for a robotic manipulator to perform continuous path, interpolated, and precise straight-line motions.
7	Object Detection via Template Matching: Apply template matching techniques using computer vision to detect, identify, and locate specific target objects within the robot's visual field.
8	Image Segmentation and Shape Analysis: Execute image segmentation algorithms to isolate polyhedral objects from their background, facilitating shape analysis for automated robotic manipulation.

Electric Vehicles

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE472	Electric Vehicles (Theory)	03	---	---	03	---	---	03
26ECPE4L72	Electric Vehicles (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Objectives:	
1	Understand the basics, need, types, and challenges of electric vehicles.
2	Learn the components and operation of battery electric vehicle drive train systems.
3	Understand the architecture and working of hybrid and fuel cell electric vehicles
4	Study power electronic converters and EV charging systems used in electric vehicles.
5	Analyze batteries, battery management systems, and alternative energy storage technologies for EV applications
6	Understand EV safety requirements, testing procedures, standards, and certification processes.

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

1	Explain the need, types, and challenges of electric vehicles.
2	Describe the construction and operation of BEV drive train components and battery systems.
3	Analyze the working principles of HEV and FCEV systems.
4	Explain the operation of EV chargers and power electronic converters.
5	Evaluate battery performance, SOC/SOH estimation, and battery management techniques.
6	Apply EV safety standards, testing methods, and regulatory requirements in electric vehicle systems.

Module	Theory Course Contents	Hrs
1	**Introduction to Electric vehicles**	**06**
1.1	Present scenario of electric vehicles, Need of Electric Vehicles, Economic and environmental impacts of using Electrical vehicles.	
1.2	Challenges faced by electric vehicles to replace ICE. Major requirements of electric vehicles.	
1.3	Types of electric vehicle and their challenges: Types of electric vehicle, Pure Electric Vehicle (PEV): Battery Electric vehicle, Fuel Cell electric vehicle (FCEV), Hybrid Electric vehicle (HEV).	
2	**Battery Electrical vehicle**	**07**
2.1	Components of BEV drive train, the electric propulsion subsystem - Power converter, Driving wheels, Suspension system, Driveshaft, Mechanical transmission, Electric Motor, power electronics converters (DC-AC/DC-DC), The electronic control unit (ECU).	
2.2	The energy source subsystem Battery pack with Battery Management System.	
2.3	On board charger, the auxiliary subsystem -Power steering unit, Common parts between ICE drive train and EV drive train, Differences (modifications/parts to be removed/added) between ICE and EV drive train.	
3	**Hybrid Electrical vehicle and Fuel cell electric vehicle**	**08**
3.1	Introduction to Hybrid Electric Vehicles ,Basic architecture of hybrid drive trains, Components of HEV drive train system Economic and environmental impacts of Electric hybrid vehicle Parameters affecting Environmental and economic analysis	
3.2	Classification of HEV: Conventional HEV (Micro, Mild and Full hybrid-series hybrid, parallel hybrid, series parallel hybrid, complex hybrid).	
3.3	Fuel cell electric vehicle (FCEV) -Basic architecture of FCEV. Components of FCEV drive train system.	
4	**On-board Chargers**	**06**
4.1	Review of semiconductor devices; turn-on and turn-off characteristics; loss computation in semiconductor devices;	
4.2	basics of non-isolated/isolated DC-DC and grid connected converters;	
4.3	classification of EV chargers; modelling and control of bi-directional DC-DC converters; discussions on V2X applications	
5	**Batteries**	06
5.1	Overview of batteries , Battery Parameters, types of batteries , Battery Charging	

5.2	Alternative novel energy sources-solar photovoltaic cells, fuel cells, super capacitors, flywheels	
5.3	Battery Modeling: Equivalent circuit models, State of Charge (SOC) and State of Health (SOH) estimation, Battery Management Systems (BMS): Cell balancing, thermal management	
6	**EV-Safety, Testing, Regulations, And Standards**	**06**
6.1	Standards Roadmap For Electric Vehicles, SAE Standards, Arai Standards	
6.2	Performance & Safety, Applicable Battery Standards, Battery Safety	
6.3	Battery Transportations, Charging Standards, Governing Bodies For Regulation, Certification Requirement & Options, Battery Characterization & Cycle Testing.	
Total		**39**

Textbooks:	
1	Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", CRC Press, 2 nd Edition, 2017. (Unit-I, II)
2	Ali Emadi, "Advanced Electric Drive Vehicles (Energy, Power Electronics, and Machines)", CRC Press, 2015. (Unit-III)
3	John G. Hayes and A. Goodarzi, "Electric Powertrain - Energy Systems, Power electronics and drives for Hybrid, electric and fuel cell vehicles", Wiley, 2018. (Unit-IV & V)
4	Electric and Hybrid Vehicles: Design Fundamentals, Iqbal Husain, CRC Press / Taylor & Francis
Reference books:	
1	James Larminie, John Lowry, "Electric Vehicle Technology Explained", Wiley, 2nd Edition 2012.
2	Power Converters for Electric Vehicles, L. Ashok Kumar and S. Albert Alexander, CRC Press / Taylor & Francis
3	Advanced Electric Drive Vehicles, Ali Emadi, CRC Press / Taylor & Francis

Access to NPTEL / Swayam Course:	
1	https://nptel.ac.in/courses/108106170
2	https://onlinecourses.nptel.ac.in/noc22_ee53
3	https://onlinecourses.nptel.ac.in/noc21_ee112

Department of Electronics and Computer Science

Electric Vehicles (Lab)

Lab Objectives:	
1	To understand the basic concepts, types, and performance characteristics of electric vehicles through simulation studies.
2	To study the operation and performance of EV drive train components, motors, and battery systems using MATLAB/Simulink.
3	To analyze the working and performance of HEV and FCEV models using simulation tools.
4	To simulate and study the operation of power electronic converters and EV charging systems.
5	To analyze battery characteristics, SOC/SOH estimation, BMS operation, and renewable energy integration in EV systems.
6	To study EV safety parameters, battery testing methods, and performance evaluation techniques using simulation and analysis tools.

Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Explain the basic operation, types, and performance characteristics of electric vehicles.
2	Simulate and analyze EV drive train systems, motors, and battery operation.
3	Analyze the working principles and performance of HEV and FCEV systems.
4	Simulate EV charging systems and analyze the operation of power electronic converters.
5	Evaluate battery performance, SOC/SOH estimation methods, and battery management techniques.
6	Perform analysis related to EV safety, battery testing, and applicable standards for electric vehicle systems.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Modeling of Basic Electric Vehicle in MATLAB/Simulink
2	Modeling of DC-DC Buck Converter
3	Modeling of Bidirectional DC-DC Converter
4	Battery Charging and Discharging Characteristics
5	State of Charge (SOC) Estimation of Battery
6	Thermal Effect Analysis on EV Battery
7	Simulation of Regenerative Braking System
8	Comparative Study of ICE and EV Efficiency
9	Simulation of Hybrid Electric Vehicle (HEV) Architecture
10	Performance Analysis of Fuel Cell Electric Vehicle
11	Modeling of EV On-board Charger
12	Vehicle-to-Grid (V2G) Power Flow Simulation
13	Modeling of Solar PV Based EV Charging System
14	Simulation of Battery Management System (BMS)
15	Comparative Analysis of EV Motors
16	EV Safety Standards and Battery Testing
17	Battery Cycle Testing and Performance Evaluation

Wireless Technology

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE473	Wireless Technology (Theory)	03	---	---	03	---	---	03
26ECPE4L73	Wireless Technology (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Objectives:	
1	To understand the fundamentals of wireless communication systems and propagation.
2	To analyze various wireless technologies and standards used in modern networks.
3	To study cellular communication, multiple access techniques, and mobility management.
4	To explore wireless networking protocols and architectures.
5	To evaluate emerging wireless technologies like 5G/6G and IoT.
6	To develop practical skills in wireless system design and performance analysis.

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

1	Explain wireless communication principles, spectrum usage, and propagation models.
2	Analyze and compare multiple access techniques and modulation scheme.
3	Understand cellular system design, handoff, and mobility management
4	Evaluate wireless network architectures and protocols (Wi-Fi, Bluetooth, etc.).
5	Assess performance issues such as interference, fading, and capacity.
6	Explore and apply concepts of emerging technologies like 5G, IoT, and beyond.

Module	Theory Course Contents	Hrs
1	**Introduction to Wireless Communication**	**06**
1.1	Evolution of wireless systems , Wireless spectrum and regulations ,Basic communication system model	
1.2	Types of wireless networks (PAN, LAN, MAN, WAN) ,Challenges in wireless communication	
2	**Radio Propagation & Channel Modeling**	**06**
2.1	Free space propagation model , Path loss models (Okumura, Hata),	
2.2	Shadowing and multipath fading ,Doppler effect ,Channel capacity and Shannon theorem	
3	**Modulation & Multiple Access Techniques**	**08**
3.1	Digital modulation techniques (ASK, FSK, PSK, QAM)	
3.2	Spread spectrum techniques (DSSS, FHSS)	
4	**Cellular Communication Systems**	**06**
4.1	Cellular concept and frequency reuse, Cell splitting, sectoring, Handoff techniques.	
4.2	GSM architecture and call processing & Introduction to LTE.	
5	**Wireless Networking & Protocols**	**07**
5.1	IEEE 802.11 (Wi-Fi) architecture, Bluetooth and ZigBee.	
5.2	Ad hoc and sensor networks, Routing in wireless networks.	
6	**Emerging Wireless Technologies**	**06**
6.1	5G architecture and features , Introduction to 6G concepts	
6.2	MIMO	
6.3	Software-defined radio (SDR) and cognitive radio	
Total		**39**

Textbooks:	
1	Wireless Communication - Vijay Garg
2	Introduction to Wireless Communications and Networks – Krishnamurthy Raghunandan
3	Wireless Communications: Theory and Techniques - Asrar U. H. Sheikh
4	Wireless Communication Electronics - Robert Sobot
Reference books:	
1	Wireless Communication Electronics by example - Robert Sobot
2	Advanced Wireless Communications and Mobile Networks
3	Wireless Sensor Networks - Jaydip Sen
4	5G and 6G Enhanced Broadband Communications - Isiaka Ajewale Alimi

Wireless Technology (Lab)

Lab Objectives:	
1	To understand practical aspects of wireless communication systems and devices.
2	To implement and analyze digital modulation techniques.
3	To study wireless channel behavior such as path loss and fading.
4	To configure and evaluate wireless networks (Wi-Fi, Bluetooth, etc.).
5	To gain hands-on experience with simulation tools (MATLAB/Python/NS-3).
6	To explore IoT-based wireless communication systems.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Implement and analyze basic wireless communication models using simulation tools.
2	Evaluate performance of modulation and multiple access techniques.
3	Analyze wireless channel characteristics like path loss and fading.
4	Configure and test wireless network protocols and devices.
5	Design and demonstrate simple IoT-based wireless systems.
6	Interpret experimental results and prepare technical reports.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
1	Simulate a block-level wireless communication system using MATLAB or Python to demonstrate signal generation, transmission, and reception.
2	Investigate wireless path loss models by comparing free space and log-distance characteristics through received power versus distance plots.
3	Implement digital modulation techniques such as ASK, FSK, PSK, and QAM to perform a Bit Error Rate (BER) versus Signal-to-Noise Ratio (SNR) analysis.
4	Simulate and compare the performance of multiple access techniques including FDMA, TDMA, and CDMA.
5	Configure a wireless local area network (Wi-Fi) to measure and analyze signal strength, throughput, and latency.
6	Study short-range wireless communication by examining device pairing, data transfer, range, and power consumption using Bluetooth or ZigBee.
7	Simulate an ad hoc wireless network using NS-3 or OMNeT++ to analyze the performance of various routing protocols.
8	Design and implement an IoT-based wireless system mini project for smart home or sensor monitoring using Wi-Fi, Bluetooth, or LoRa modules.

Cloud Computing and GPU

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE571	Cloud Computing and GPU (Theory)	03	---	---	03	---	---	03
26ECPE5L71	Cloud Computing and GPU (Lab)	---	02	---	---	01	---	01
							Total Credits	

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite:

1. Computer Communication Networks
2. IoT and Embedded Systems
3. Operating Systems fundamentals
4. Python/C/C++ Programming
5. Basics of Computer Architecture and Linux environment

Course Objectives:

1	To understand cloud computing architectures and virtualization technologies.
2	To study distributed cloud systems, storage, and cloud security mechanisms.
3	To explore containerization and orchestration techniques for scalable applications.
4	To understand GPU architecture and parallel computing concepts.
5	To develop CUDA/OpenCL based GPU programming skills.
6	To design cloud-GPU integrated solutions for AI, IoT, and edge computing applications

Course Outcomes:

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

1	Explain cloud computing models, architectures, and virtualization concepts.
2	Analyze distributed cloud systems, storage frameworks, and security mechanisms.
3	Deploy containerized applications using Docker and orchestration platforms.
4	Understand GPU architecture and parallel computing performance metrics.
5	Develop and optimize CUDA/OpenCL programs for engineering applications.
6	Design heterogeneous cloud-GPU solutions for AI, IoT, and embedded systems.

Module	Theory Course Contents	Hrs
1	**Introduction to Cloud Computing**	**06**
1.1	Fundamentals of Cloud Computing: Evolution of distributed and cloud computing, Characteristics and advantages of cloud computing	
1.2	Cloud Service and Deployment Models: IaaS, PaaS, SaaS, Public, Private, Hybrid, and Community clouds	
1.3	Cloud Architecture and Data centers: NIST cloud reference architecture, Data center overview and resource provisioning	
1.4	Cloud Applications: Applications in IoT and embedded systems, Load balancing and SLA concepts	
2	**Virtualization and Containerization**	**06**
2.1	Virtualization Fundamentals: Concepts and advantages of virtualization, Type I and Type II hypervisors	
2.2	Resource Virtualization: Virtualization of CPU, memory, storage, and I/O devices, Virtual machines and resource allocation	
2.3	Containerization Concepts: Introduction to containers, Docker architecture and container lifecycle	
2.4	Cloud Deployment Tools: Docker images and containers, Overview of container-based deployment	
3	**Distributed Cloud Systems and Security**	**07**
3.1	Distributed Cloud Computing: Distributed computing fundamentals, CAP theorem and distributed systems	
3.2	Cloud Storage Systems: Distributed storage systems, NoSQL databases, BigTable, and DynamoDB	
3.3	Cloud Security and Privacy: Identity and Access Management (IAM), Cloud security threats, encryption, and privacy	
3.4	Reliability and Infrastructure Management: Backup and disaster recovery, Introduction to Infrastructure as Code (IaC)	
4	**Cloud Orchestration and Edge Integration**	**05**
4.1	Container Orchestration: Kubernetes fundamentals, Container orchestration concepts	
4.2	Cloud Resource Management: Auto scaling and monitoring, Cloud resource management techniques	
4.3	Server less and Edge Computing: Server less computing overview, Edge computing concepts	
4.4	IoT-Cloud Integration: Edge-cloud communication architecture, Industrial IoT cloud platform case studies	

5	**GPU Architecture and Parallel Computing**	**07**
5.1	Parallel Computing Fundamentals: Introduction to parallel computing, Latency vs throughput computing	
5.2	GPU Architecture: CPU vs GPU architecture, Multi-core and many-core processors: SIMT architecture, GPC, and Streaming Multiprocessors	
5.3	GPU Memory and Scheduling: Warp scheduling concepts, GPU memory hierarchy: Global memory, Shared memory, Constant memory, Texture memory	
5.4	GPU Performance Metrics: Speedup, efficiency, and scalability, Brief introduction to Amdahl's Law, Overview of OpenCL framework	
6	**CUDA Programming and Heterogeneous AI Systems**	**07**
6.1	CUDA Programming Fundamentals: CUDA programming environment setup, CUDA kernels and thread organization, Grid, block, and thread hierarchy	
6.2	GPU Programming Optimization: Synchronization mechanisms, Memory transfer between CPU and GPU, Shared memory optimization and memory coalescing	
6.3	CUDA-Based Parallel Applications: Vector and matrix operations using CUDA, Reduction operations, GPU acceleration for image and signal processing	
6.4	GPU for AI and Edge Systems: Tensor Cores and hardware accelerators, Jetson Nano and embedded GPU platforms, GPU integration with TensorFlow/PyTorch, Applications in AI, IoT, and smart embedded systems	
	Total	**39**

Textbooks:	
1	Cloud Computing, "Cloud Computing", 2nd edition, Wiley India Publications.
2	Mastering Cloud Computing, "Mastering Cloud Computing", McGraw Hill Education Publications.
3	Programming Massively Parallel Processors, "Programming Massively Parallel Processors: A Hands-on Approach", 4th edition, Morgan Kaufmann Publications.
4	CUDA by Example, "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison-Wesley Publications.
5	Distributed and Cloud Computing, "Distributed and Cloud Computing", Morgan Kaufmann Publications

Reference books:	
1	Cloud Computing, "Cloud Computing: A Hands-On Approach", Universities Press Publications.
2	Introduction to Parallel Computing, "Introduction to Parallel Computing", 2nd edition, Pearson Education Publications.
3	GPU Computing Gems, "GPU Computing Gems Emerald Edition", Morgan Kaufmann Publications.
4	Cloud Security and Privacy, "Cloud Security and Privacy", O'Reilly Media Publications.
5	CUDA Programming, "CUDA Programming: A Developer's Guide to Parallel Computing with GPUs", Morgan Kaufmann Publications.
	Docker Deep Dive, "Docker Deep Dive", Leanpub Publications.
6	Kubernetes Up and Running, "Kubernetes: Up and Running", O'Reilly Media Publications.
7	Hands-On GPU Programming with Python and CUDA, "Hands-On GPU Programming with Python and CUDA", Packt Publishing Publications.
8	Cloud Computing, "Cloud Computing: A Hands-On Approach", Universities Press Publications.

Cloud Computing and GPU (Lab)

Lab Objectives:	
1	Introduce cloud computing service models, virtualization tools, and public cloud deployment workflows.
2	Implement containerization technologies using Docker and multi-container orchestration with Docker Compose and Kubernetes.
3	Configure GPU programming environments and utilize CUDA toolkits for hardware acceleration.
4	Develop parallel computing kernels for vector operations, matrix multiplication, and image processing.
5	Evaluate performance gains of GPU architectures over traditional CPUs and optimize memory usage.
6	Integrate cloud platforms, IoT telemetry, and Edge GPU computing in a comprehensive mini-project.
Lab Outcomes: After successful completion of the lab course students will be able to:	
1	Deploy virtual machines and cloud-hosted web server applications across virtualization platforms and AWS/GCP.
2	Execute containerized applications and manage orchestration clusters using Docker and Kubernetes.
3	Configure CUDA development environments and write device query scripts to inspect GPU hardware.
4	Implement parallel CUDA kernels for efficient data processing, matrix multiplication, and neural network inference.
5	Analyze and benchmark parallel execution performance on CPU versus GPU architectures.
6	Design an end-to-end cloud-GPU integrated application for AI and IoT systems.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr.No.	Name of the Experiments
	Part A – Cloud Computing
1	Study of cloud computing platforms and cloud service models.
2	Installation and configuration of Virtual Box/VMware and creation of virtual machines.
3	Deployment and management of Linux virtual machines on cloud platforms.
4	Creating and configuring AWS EC2 or Google Cloud virtual machine instances.
5	Deployment of a web server application on a cloud platform.
6	Installation and configuration of Docker environment.
7	Creation and execution of Docker containers and Docker images.
8	Deployment of multi-container applications using Docker Compose.
9	Kubernetes cluster setup and basic container orchestration.
10	IoT sensor simulation using Python and uploading telemetry data to cloud storage/database.
11	IoT sensor simulation using Python and uploading telemetry data to cloud storage/database.
Part B – GPU	
12	Installation and configuration of CUDA Toolkit and GPU programming environment.
13	CUDA device query program to analyze GPU properties and specifications.
14	Implementation of vector addition using CUDA threads and blocks.
15	Implementation of matrix multiplication using CUDA kernels.
16	Comparative analysis of CPU and GPU performance for parallel applications.
17	Optimization of matrix operations using GPU shared memory.
18	Parallel image processing using CUDA programming.
19	Implementation of CUDA accelerated neural network inference using TensorFlow/PyTorch.
20	Edge AI implementation using Jetson Nano or equivalent embedded GPU platform.
21	Mini Project: Design and implementation of a Cloud-GPU integrated application for AI/IoT systems.
22	Installation and configuration of CUDA Toolkit and GPU programming environment.
23	CUDA device query program to analyze GPU properties and specifications.
24	Implementation of vector addition using CUDA threads and blocks.

Suggested Software and Tools	
1	Docker
2	Kubernetes
3	VirtualBox / VMware
4	NVIDIA CUDA Toolkit
5	Python
6	TensorFlow / PyTorch
7	OpenCL SDK
8	Google Colab
9	AWS Educate / Google Cloud Platform / Microsoft Azure
10	Jetson Nano Development Kit

Cyber Security									
Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned				
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE572	Cyber Security (Theory)	03	---	---	03	---	---	03
26ECPE5L72	Cyber Security (Lab)	---	02	---	---	01	---	01
							Total Credits	04

Examination Scheme					
Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
20	20	60	25	25	150

Course Prerequisite: Computer Networks	
Course Objectives:	
1	Introduce cyberspace concepts, cybercrime classifications, and malware threats.
2	Examine attack techniques, reconnaissance methods, and social engineering.
3	Analyze security vulnerabilities and prevention strategies for wireless and mobile networks.
4	Explore web application security risks, browser attacks, and network-level threats.
5	Understand information security compliance standards, privacy regulations, and cyber laws.
6	Investigate financial security case studies and the role of AI/ML in cybersecurity.
Course Outcomes: After successful completion of the course students will be able to:	
1	Explain cyberspace fundamentals, cyber hygiene, and malware mechanics.
2	Identify technical attack vectors, reconnaissance, and social engineering countermeasures.
3	Implement preventive measures against wireless exploits and mobile security scams.
4	Evaluate web vulnerabilities, session hijacking, and network DDoS defenses.
5	Interpret compliance standards, privacy regulations, and Indian cyber laws.
6	Assess digital financial security and AI/ML applications in cybersecurity.

Module	Theory Course Contents	Hrs
1	**Introduction to Cyberspace**	**10**
1.1	**Prerequisite:** Computer Networks **Cyber Crime:** Cybercrime definition, Types of Cybercrime. Classifications of cybercrime, Cyber Hygiene, Types of Hackers - Hackers and Crackers - Cyber-Attacks and Vulnerabilities - Malware threats - Sniffing - Gaining Access - Escalating Privileges - Executing Applications - Hiding Files - Covering Tracks - Worms - Trojans - Viruses - Backdoors	
1.2	**Cyber Attacks:** Cyber-attack Lifecycle, social engineering, Cyber stalking, Cybercafé and Cybercrimes, Botnets, Attack vector, Attacks on Wireless and mobile Networks.	
2	**Cyber-crime Attacks and Techniques**	**08**
2.1	**Attacks Techniques:** Password Cracking, Keyloggers and Spywares Steganography, Identity Theft (ID Theft), Banner Grabbing Techniques, ransom wares, Crypto wares	
2.2	Network information gathering, vulnerability scanning, Virtual Private Networks (VPN), Open Port Identification, Social engineering, Types of social engineering, How cyber-criminal works? Prevention from being victim of social engineering.	
3	**Cyber Attacks and Preventions**	**06**
3.1	Attacks on WIFI and prevention, traditional techniques, theft of internet hours, Wi-Fi measures	
3.2	Attacks on Mobile phone and prevention, mobile phone theft, mobile virus, Mishing, vishing, smishing, hacking Bluetooth	
4	**Web and Network Security**	**08**
4.1	Web Security: WASP, 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	
4.2	Network security: DOS, DDOS, defences against Denial-of-Service Attacks. Virtual Private Networks (VPN)	
5	**Cyber Laws**	**04**
5.1	**Information Security Privacy and Standard Compliances (WR)** HIPPA, FISMA, PCI DSS, GDPR, Intellectual Property Aspect of Cyber Law, Creative Commons Library, Data Protection Laws in India.	

6	**Cyber Security Initiatives- (case studies)**	**03**
6.1	Online Banking, Mobile Banking Security, Security of Debit and Credit Card, UPI Security	
6.2	Role of AI/ML in Cyber Security	
Total		**39**

Textbooks:	
1	Nina Godbole,Sunit Belapure, "Cyber Security-Understanding Cyber Crimes,Computer Forensics and Legal Perspective",Wiley-India,2011.
2	The Complete Cyber Security Course -Volume 1- Nathan House
3	Network Security Bible, Eric Cole, Second Edition, Wiley
Reference books:	
1	The Information technology Act, 2000; Bare Act- Professional Book Publishers, New Delhi.
2	James Graham,Richard Howard ,Ryan Olson. " Cyber Security Essentials,CRC Press,2018 print.
3	Build your own Security Lab, Michael Gregg, Wiley India
4	Computer Security, Dieter Gollman, Third Edition, Wiley

Cyber Security (Lab)

Lab Objectives:	
1	To provide practical exposure to cybersecurity concepts, tools, and technologies.
2	To develop skills in identifying, analyzing, and mitigating cyber threats.
3	To perform security assessments of systems, networks, and applications.
4	To understand cyber attack methodologies and defensive strategies.
5	To promote cyber hygiene and secure computing practices.
6	To enable students to apply cybersecurity principles in real-world scenarios.
Lab Outcomes: After successful completion of the lab course students will have:	
1	Demonstrate understanding of cybersecurity fundamentals and cyber threats.
2	Perform basic security assessments and vulnerability analysis.
3	Apply cybersecurity tools and techniques in controlled environments.
4	Evaluate the security posture of networks, wireless systems, and web applications.
5	Detects and responds to common cyber attacks and social engineering threats.
6	Design and implement basic cybersecurity solutions and security awareness

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr.No.	**Name of the Experiments**
1	Perform reconnaissance to find all the relevant information on selected websites using 5 network information gathering tools.
2	Identifying the target website and perform vulnerability assessment using Google dorking, netcraft, shodan and social media
3	Implementation of active reconnaissance using different tools – nmap, telnet, nikto
4	Install Wire shark and apply filters to gather different information related to protocols
5	Perform Session hijacking/ find credentials of unsecure real time website using Wireshark
6	Implementation of active reconnaissance using Angry IP scan
7	Generate Word list using wordlist generator Crunch
8	Perform windows login bypass using net user and using John the Ripper
9	Simulation for offensive attack using tryhackme safe and virtual environment
10	Create Trojan and Exploit victim's machine by taking its complete access
11	Scan systems to identify open ports and understand associated risks.
12	Study Wi-Fi security standards (WEP, WPA, WPA2, WPA3) and implement secure wireless configurations.
13	Demonstrate common wireless vulnerabilities and understand mitigation techniques in a controlled setup.
14	Examine mobile security settings, permissions, encryption, and application security.
15	Create simulated phishing, vishing, and smishing scenarios and identify prevention techniques.
16	Examine browser cookies, session identifiers, and session management mechanisms.
17	Identify common web vulnerabilities based on OWASP principles using a deliberately vulnerable web application.
18	Analyze suspicious emails and websites to identify indicators of phishing and pharming attacks.
19	Understand DoS/DDoS attack mechanisms and evaluate defensive strategies through simulations and case studies.
20	Configure a VPN connection and analyze secure communication and encryption mechanisms.

Blockchain Technology

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECPE573	Blockchain Technology (Theory)	03	---	---	03	---	---	03
26ECPE5L73	Blockchain Technology (Lab)	---	02	---	---	01	---	01
							Total Credits	**04**

Course Prerequisite: Computer Networks; Operating Systems; Cryptography and Network Security	
Course Objectives:	
1	Build the conceptual base required for understanding decentralized systems.
2	Understand cryptographic tools used in blockchain systems.
3	Understand how blockchain systems are built and maintained.
4	Deep dive into real-world blockchain platforms.
5	Build and integrate decentralized applications.
6	Explore modern applications and future directions.
Course Outcomes: After successful completion of the course students will be able to:	
1	Understand Distributed Systems and Blockchain Fundamentals
2	Apply Cryptographic Techniques in Blockchain Systems
3	Analyze Blockchain Architecture and Consensus Mechanisms
4	Develop and Evaluate Blockchain Platforms (Bitcoin & Ethereum)
5	Design and Build Decentralized Applications (dApps)
6	Evaluate Advanced Blockchain Applications and Emerging Trends

Module	Theory Course Contents	Hrs
1	**Foundations of Distributed Systems**	**04**
1.1	Introduction to Blockchain and Web3 evolution, Centralized vs decentralized architectures, Basics of distributed systems, CAP theorem and system trade-offs, Byzantine fault tolerance problem, Consensus problem and FLP impossibility.	
2	**Cryptographic Foundations**	**05**
2.1	Hash functions (SHA-256) and properties, Public key cryptography, Digital signatures, Merkle trees and data integrity, Introduction to Zero-Knowledge Proofs, Commitment schemes and advanced primitives	
3	**Blockchain Architecture & Consensus**	**06**
3.1	Structure of a blockchain (blocks, chain, hashes), Transaction lifecycle, Consensus mechanisms: PoW, PoS, PBFT, Mining and incentives, Game theory in blockchain systems, Types of blockchains (public, private, consortium)	
4	**Bitcoin & Ethereum Systems**	**08**
4.1	Bitcoin architecture and UTXO model, Mining process and difficulty adjustment, Bitcoin limitations, Ethereum architecture and EVM, Smart contracts introduction, Solidity programming basics and advanced concepts, Gas mechanism and optimization, Smart contract design patterns, Security vulnerabilities (reentrancy, overflow, etc.)	
5	**dApps & Enterprise Blockchain**	**08**
5.1	dApp architecture, Web3.js / Ethers.js libraries, Wallet integration (MetaMask), Frontend + blockchain integration (React + Web3), Hyperledger Fabric architecture, Channels and chaincode, Enterprise blockchain use cases (supply chain, banking)	
6	**Advanced Blockchain Systems**	**08**
6.1	Decentralized Finance (DeFi), NFTs and token standards (ERC-721, ERC-20), Layer 2 scaling solutions (rollups, sidechains), Cross-chain interoperability and bridges, Blockchain security auditing techniques, Privacy technologies (ZKPs, mixers), Regulation and legal frameworks (India focus), Future of Web3 and blockchain.	
	Total	**39**

Textbooks:	
1	Imran Bashir, Mastering Blockchain (4th Edition), Packt Publishing *(Comprehensive coverage of blockchain architecture, cryptography, Bitcoin, Ethereum, smart contracts, and decentralized applications.)*
2	Daniel Drescher, Blockchain Basics: A Non-Technical Introduction in 25 Steps, Apress, *(Provides a clear conceptual introduction to blockchain, decentralization, consensus mechanisms, and smart contracts.)*
3	Andreas M. Antonopoulos, Mastering Bitcoin O'Reilly Media, *(Detailed technical explanation of Bitcoin protocol, UTXO model, mining, and transaction structures.)*
4	Andreas M. Antonopoulos & Gavin Wood, Mastering Ethereum, O'Reilly Media *(Covers Ethereum architecture, EVM, Solidity programming, and decentralized application development.)*
Reference books:	
1	Ferguson, Schneier, Kohno, Cryptography Engineering, Wiley *(Practical cryptographic design principles used in secure systems.)*
2	Jean-Philippe Aumasson, Serious Cryptography, No Starch Press *(Modern cryptographic techniques including hashing, encryption, and protocol design.)*
3	Don Tapscott & Alex Tapscott, Blockchain Revolution, Portfolio / Penguin *(Discusses the impact of blockchain on business, finance, and governance.)*
4	Antony Lewis, The Basics of Bitcoins and Blockchains, Mango Publishing *(Beginner-friendly explanation of Bitcoin, blockchain systems, and digital currencies.)*
5	Imran Bashir (Editor), Distributed Computing to Blockchain: Architecture, Technology, and Applications, Elsevier. *(Covers evolution from distributed systems to blockchain technology.)*
6	Academic Paper (Survey), SoK: Cryptography in Blockchain Systems *(Comprehensive research survey on cryptographic techniques in blockchain systems.)*

Blockchain Technology (Lab)

Lab Prerequisite: JavaScript or Python programming, concepts of Data Structures and algorithms, Knowledge of basic Cryptography concepts, Computer Networks,	
Lab Objectives:	
1	To set up and configure a blockchain development environment using tools such as Ganache, Truffle, and Hardhat for efficient development and testing.
2	To implement fundamental cryptographic primitives, including hashing algorithms like SHA-256 and digital signatures, for securing blockchain systems.
3	To design and simulate basic blockchain architectures by modeling blocks, transactions, and consensus mechanisms in a distributed ledger system.
4	To develop, test, and deploy smart contracts using Solidity on platforms such as Ethereum.
5	To build decentralized applications (dApps) that interact with blockchain networks using libraries such as Web3.js and Ethers.js.
6	To analyze the security and performance of blockchain systems by identifying vulnerabilities and evaluating metrics such as throughput, latency, and gas consumption.
Lab Outcomes:	
1	Setup and Configure Blockchain Development Environment
2	Implement Cryptographic Primitives for Blockchain
3	Design and Simulate Basic Blockchain Systems
4	Develop and Deploy Smart Contracts
5	Build Decentralized Applications (dApps)
6	Analyze Security and Performance of Blockchain Systems

Suggested Experiments: Students are required to complete at least 08 experiments.	
Sr.No.	**Name of the Experiments**
1	Blockchain Environment Setup - Install and configure blockchain development environment. Tools: Node.js, Ganache / Hardhat, MetaMask Outcome: Students can set up a local blockchain development environment.
2	Hash Function Implementation - Implement SHA-256 hashing and analyze properties. Tools:Python / JavaScript, Outcome: Understand collision resistance, avalanche effect, and determinism.
3	Basic Blockchain Creation - Build a simple blockchain with blocks and hash linking. Tools:Python / JavaScript Outcome: Understand how blocks are chained using cryptographic hashes.
4	Proof of Work Simulation - Simulate mining using Proof of Work algorithm. Tools: Python / Node.js Outcome: Understand mining difficulty and computational effort.
5	Digital Signature Implementation - Generate and verify digital signatures for transactions. Tools: Python (cryptography library)

	Outcome: Understand authentication and non-repudiation in blockchain.
6	Merkle Tree Construction - Construct a Merkle tree and verify transactions. Tools: Python Outcome: Understand efficient data verification in blockchain systems.
7	Smart Contract Development (Basic) - Write a simple smart contract in Solidity. Tools: Remix IDE, Solidity Outcome: Understand structure and deployment of smart contracts.
8	Smart Contract Deployment on Testnet - Deploy contract on Ethereum test network. Tools: MetaMask,Remix / Hardhat Outcome: Learn real-world deployment workflow.
9	dApp Development - Build a simple decentralized application (frontend + blockchain). Tools: React.js, Ethers.js / Web3.js, MetaMask Outcome: Understand full-stack blockchain application development.
10	Security Analysis of Smart Contracts - Identify vulnerabilities in smart contracts. Tools: Remix IDE, Static analysis tools Outcome: Understand attacks like reentrancy, overflow, and unsafe access control.

Research Methodology

Course Code	Course Name	Teaching Scheme (Hours per week)			Credits Assigned			
		TH	PR	Tut	TH	PR	Tut	Total
26ECRM71	Research Methodology	04	---	---	04	---	---	04
							Total Credits	**04**

Examination Scheme

Mid Term	Continuous Assessment	End Semester Exam	Term Work	Practical & Oral	Total
--	100	--	--	--	100

Course Objectives: The course aims to:	
1	Develop an understanding of the fundamentals of engineering research and research methodology.
2	Develop skills in literature review, data collection, data analysis, and experimental design.
3	Develop the ability to prepare structured engineering research project proposals.
4	Understand the principles of technical paper writing, patent drafting, and scientific documentation.
5	Enhance technical communication skills through scientific writing and technical presentations.
6	Promote ethical research practices through awareness of plagiarism and intellectual property rights.

Course Outcomes: After successful completion of the course students will be able to:	
1	Apply research methods, experimental design, and data analysis techniques to engineering research.
2	Identify research problems and conduct literature reviews for engineering applications
3	Develop a structured project proposal with clear objectives, methodology, and expected outcomes.
4	Prepare technical documents, including research papers and patent drafts, following standard scientific writing practices.
5	Prepare and deliver technical reports and presentations using appropriate scientific communication practices
6	Apply ethical research practices by identifying plagiarism and demonstrating awareness of intellectual property rights.

Research Methodology

Course Work: Prescribed MOOC Course

Course work evaluation: **Internal Continuous Assessment** shall be based on:

- MOOC Course Assignments
- Project Proposal and Presentation
- Patent File / Technical Paper Writing
- Plagiarism Report
- Oral Examination (Viva-Voce)

NPTEL Course Link: https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_ge79

Rubrics : Internal Continuous Assessment				
Sr. No.	**Assessment Component**	**Submission Timelines**	**Description**	**Marks**
1	MOOC Course Assignments	Throughout the semester	Evaluation based on performance in the prescribed NPTEL assignments/quizzes.	**25**
2	Project Proposal and Presentation	By Mid-term exams	Preparation of a project proposal in the prescribed format and presentation before the evaluation committee.	**25**
3	Patent File / Technical Paper Writing	Last week of the semester	Preparation of a patent draft or technical paper based on the project/research work.	**25**
4	Plagiarism Report	Twice in the semester	Submission of a plagiarism report for the project proposal or technical paper as per the prescribed similarity index.	**05**
5	Oral Examination (Viva-Voce)	Last week of the semester	Oral examination based on the prescribed NPTEL course syllabus and related concepts.	**20**
			Total	**100**

Department of Electronics and Computer Science

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/PR	Tut	Total
26ECCP271	Capstone Project – II	---	4#	---	---	02	---	02

 # indicate workload of learner not faculty

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	Continuous Assessment				
26ECCP271	Capstone Project – II	---	---	---	50	100	150

Capstone Project – II: Objectives
Advanced Implementation & Full-Scale Integration **Objective 1** : Scale up the modular prototypes or simulations developed in Semester-6 into a fully operational, end-to-end integrated system or product. *NEP Alignment: Moving from theoretical concepts and partial builds to complete experiential learning and operational reality.*
Rigorous Testing, Validation, and Optimization **Objective 2**: Subject the completed project to rigorous stress testing, edge-case analysis, performance benchmarking, and debugging to ensure reliability, safety, and efficiency. *NEP Alignment: Fostering a scientific temperament, critical inquiry, and quality-conscious technical capability.*
Research, Innovation, and Intellectual Property (IP) Generation **Objective 3**: Encourage students to identify novel elements in their work suitable for publishing research papers in peer-reviewed journals/conferences or filing for design patents/copyrights. *NEP Alignment: Boosting India's ecosystem for research, innovation, and knowledge creation as envisioned by NEP 2020.*

Industry-Alignment, Commercialization, & Start-Up Incubation **Objective 4**: Evaluate the economic viability, market-fit, and scalability of the project, transforming viable engineering prototypes into minimum viable products (MVPs) or potential start-up ventures. *NEP Alignment: Promoting entrepreneurship, self-reliance (Atmanirbhar Bharat), and industry-academia collaboration.*
Societal Impact and Sustainable Development Goals (SDGs) **Objective 5**: Ensure the final project explicitly addresses localized community problems, environmental sustainability, green technologies, or inclusive development. *NEP Alignment: Instilling social responsibility, ethical engineering values, and a commitment to global citizenship.*
Advanced Technical Communication & Professional Defense **Objective 6**: Master professional documentation, technical writing (thesis compilation), and master the art of defending complex engineering decisions before an expert evaluation panel. *NEP Alignment: Strengthening high-order cognitive skills, communication clarity, and professional readiness.*

Capstone Project – II: Outcomes
1. Technical Execution and Problem-Solving • Implementation of Design: Successfully translate the detailed design, system architecture, or blueprint formulated during the planning phase into a functional prototype, model, software build, or process framework. • Application of Advanced Knowledge: Synthesize and apply core technical competencies, specialized elective concepts, and modern engineering/IT tools acquired throughout the preceding semesters to solve complex, open-ended problems. • Testing and Validation: Conduct rigorous testing (e.g., unit/integration testing, performance evaluation, or experimental analysis), interpret data accurately, and refine the solution based on test metrics.
2. Research and Critical Thinking • Investigation and Analysis: Critically analyze technical challenges, troubleshooting hurdles, and design trade-offs encountered during execution using sound engineering methodologies. • Information Synthesis: Gather, filter, and integrate relevant technical literature, data sheets, standards, or market research to optimize project performance.

3. Project Management and Team Dynamics

- Resource and Time Management: Demonstrate effective management of timelines, milestones, budgets, and physical/digital resources to deliver the project outcome on schedule.
- Collaborative Teamwork: Function productively as an individual contributor as well as an active team member or leader, fostering mutual accountability, task division, and conflict resolution.

4. Professional Practice, Ethics, and Impact

- Societal and Environmental Considerations: Evaluate the broader implications of the project on society, public health, safety, legal frameworks, and environmental sustainability.
- Professional Ethics: Adhere to professional standards, intellectual property guidelines, and ethical norms while designing and executing solutions.

5. Communication and Documentation

- Technical Writing: Produce a comprehensive, well-structured project report, user manuals, and technical documentation suitable for future maintenance or commercial scaling.
- Effective Presentation: Articulate design decisions, project findings, and operational demonstrations clearly through technical presentations and defense/viva voce sessions before academic and professional evaluators.

6. Lifelong Learning and Innovation

- Continuous Skill Acquisition: Demonstrate the ability to independently research, learn, and adapt to unfamiliar tools, programming languages, hardware components, or industry standards not covered in the standard curriculum.
- Innovative Mindset: Identify avenues for future enhancement, commercialization, or patentable research based on the project outcomes, fostering an entrepreneurial and continuous-improvement approach.

Capstone Project-2: Continuity guidelines

1. Execution Transition and Scope Management:

- Transition from planning to execution: Capstone Project-II directly builds upon the finalized scope, system architecture, requirements specifications, and blueprints formulated during Capstone-I.
- Adherence to Feedback: Incorporate all modifications, critical corrections, and suggestions recommended by the faculty guide or evaluation panel during the previous semester's final defense.
- Scope Lock: Avoid unapproved major pivots or changes in the core problem statement unless explicitly authorized by the project mentor/department coordinator due to unforeseen technical roadblocks.

2. Implementation and Milestone Tracking

- Milestone Execution: Strictly follow the timeline, Gantt chart, or action plan developed in the prior semester, executing tasks phase-by-phase (e.g., procurement, coding, circuit assembly, and data gathering).
- Project Diary / Logbook: Maintain an updated, dated weekly logbook or digital journal detailing individual contributions, weekly targets achieved, and hurdles faced, and mentor sign-offs.
- Regular Mentorship Interlocution: Schedule mandatory periodic meetings (weekly or fortnightly) with the designated faculty guide to demonstrate incremental progress and obtain formal feedback.

3. Testing, Validation, and Quality Assurance

- Proof of Concept / Prototype Realization: Transition theoretical constructs into a working model, operational software build, or functional simulation.
- Rigorous Testing Protocol: Conduct systematic evaluations (such as unit testing, performance benchmarking, stress testing, or comparative analysis against baseline data) to validate results.
- Constraint Compliance: Ensure the developed solution respects predefined industrial standards, safety regulations, cost constraints, and environmental guidelines.

4. Evaluation and Review Structure

- Periodic Reviews: Successfully clear mandatory institutional evaluations—typically divided into mid-term progress evaluations and final pre-submission reviews.
- Demonstration Readiness: Maintain a functional setup, presentation deck, and supporting artifacts ready for live demonstrations during the final evaluation.
- Individual Accountability: Be prepared for individual technical questioning (viva voce) during final presentations to demonstrate thorough personal understanding of the entire project lifecycle.

5. Documentation and Final Submissions

- Comprehensive Report Writing: Draft the final project report in continuation with the Phase-I documentation, strictly following institutional formatting rules (Title page, Certificates, Literature Survey, Design Details, Results, and Conclusion).
- Artifact Handover: Submit all required deliverables on or before the deadline, which usually include soft copies of source code/designs, user manuals, a hardware prototype (if applicable), and hard/soft copies of the certified final report.

Assessment guidelines for B.Tech. Capstone project II in 50 marks termwork and 100 marks oral practical

Termwork focuses on continuous evaluation by the domain experts, consistency of the students, documentation by the students, and the technical depth achieved during the semester.

1. Continuous Progress & Execution (20 Marks)

- **System Development (10 Marks):** Successful integration of modules, hardware fabrication, or software coding.
- **Weekly Attendance & Diary (5 Marks):** Regularity in meeting the guide and maintaining a project logbook.
- **Teamwork & Contribution (5 Marks):** Individual workload distribution and collaborative effort within the group.

2. Report Writing & Documentation (15 Marks)

- **Technical Content (5 Marks):** Depth of literature review, methodology clarity, and correctness of data/results.
- **Formatting & Structure (5 Marks):** Adherence to institute formatting guidelines, citations, and reference styles.
- **Plagiarism & Originality (5 Marks):** Plagiarism report verification (typically under 10–15% allowed) and novelty.

3. Mid-Term Progress Presentation (15 Marks)

- **Technical Understanding (5 Marks):** Ability to explain the architecture, algorithms, or design choices.
- **Milestone Achievement (5 Marks):** Percentage of the project completed against the initially planned timeline.
- **Presentation Skills (5 Marks):** Quality of slides, time management, and handling of internal panel questions.

Oral & Practical Assessment (100 Marks)

The final oral and practical exam evaluates the working prototype, the final outcomes, and individual subject command in front of an external examiner.

1. Project Demonstration & Working Model (40 Marks)

- **Functional Prototype (20 Marks):** The system works as intended without critical errors or crashes.
- **Testing & Validation (10 Marks):** Presentation of test cases, data analysis, accuracy metrics, or stress tests.
- **Innovation & Complexity (10 Marks):** Creative problem-solving, engineering design constraints, and societal/environmental impact.

2. Presentation & Viva-Voce (40 Marks)

- **Individual Viva Q&A (20 Marks):** Core domain knowledge, understanding of tools used, and individual contribution.
- **Final Presentation (10 Marks):** Clarity in explaining the problem statement, final outcomes, and future scope.
- **Project Outcomes (10 Marks):** Evidence of research paper publication, patent filing, or industry/community implementation.

3. Final Project Report Evaluation (20 Marks)

- **Comprehensive Review (10 Marks):** Overall quality, depth of conclusion, and future recommendations.
- **Engineering Standards (10 Marks):** Use of standard engineering tools, compliance codes, and safety protocols.

Department of Electronics and Computer Science

Syllabus (NEP Scheme)

Sem-VIII
A.Y. 2026-27

¥ - Students are required to complete a 12 weeks MOOC course on research methodology.

Semester VIII Teaching Scheme								
Course Type	**Course Name**	**Teaching Scheme (Contact hours)**			**Credits Assigned**			
		TH	**PR**	**TUT**	**TH**	**PR**	**TUT**	**TOTAL**
26ECPC81	MOOC Course 1	3	-	-	3	-	-	3
26ECPC82	MOOC Course 2	3	-	-	3	-	-	3
26ECOJT81	Internship/OJT	-	-	-	-	-	-	12€
Total Credits								**18**

€ VESIT Internship policy handbook.

Semester VIII Teaching Scheme							
Course Type	**Course Name**	**TH**	**MT**	**CA**	**TW**	**PR/OR**	**Total**
26ECPC81	MOOC Course 1	-	-	-	-	-	100
26ECPC82	MOOC Course 2	-	-	-	-	-	100
26ECOJT81	Internship/OJT	-	-	-	-	-	100
Total Marks							300

VESIT INTERNSHIP POLICY HANDBOOK (2026–27)

(Proposed)

Table of Contents

1. INTRODUCTION AND INSTITUTIONAL FRAMEWORK

1.1 About the Institute

Vivekanand Education Society’s Institute of Technology (VESIT) is an autonomous engineering institution that has consistently emphasized academic excellence, industry relevance, and holistic student development. The institute offers undergraduate and postgraduate programs across diverse disciplines including Computer Engineering, Information Technology, Artificial Intelligence & Data Science, Electronics & Computer Science, Automation & Robotics, Electronics & Telecommunications, and the Master of Computer Applications (MCA) program.

Being aligned with the National Education Policy (NEP 2020), VESIT has adopted a progressive academic framework that integrates experiential learning, multidisciplinary exposure, and skill-based education. The institute strongly believes that classroom learning alone is insufficient to prepare students for the dynamic demands of the industry. Therefore, structured industry engagement through internships has been embedded as a critical component of the curriculum.

1.2 Internship Philosophy

The internship program at VESIT is conceptualized as a **capstone academic experience** that bridges the gap between theoretical knowledge and professional practice. It is designed not merely as a training exercise but as a structured academic intervention that enables students to engage with real-world problems, industry tools, and organizational processes.

The philosophy underlying this program is rooted in the belief that meaningful learning occurs when students apply concepts in practical contexts. By immersing students in professional environments for an extended duration of six months, the institute ensures that they develop technical proficiency, professional discipline, and workplace adaptability.

The internship is therefore treated as a **credit-bearing academic course**, subject to continuous evaluation, documentation, and faculty supervision, ensuring accountability and academic rigor.

1.3 Scope and Applicability

This policy applies uniformly to all students enrolled in:

- Bachelor of Engineering (B.E.) – Semester VIII
- Master of Computer Applications (MCA) – Semester IV

The policy governs all types of internships undertaken by students, including industry internships, research internships, startup engagements, government or NGO assignments, and in-house academic internships.

It defines the roles, responsibilities, processes, and evaluation mechanisms associated with the internship program and ensures that all stakeholders operate within a clearly defined and transparent framework.

2. OBJECTIVES AND LEARNING OUTCOMES

2.1 Academic Objectives

The primary academic objective of the internship program is to enable students to integrate theoretical knowledge acquired during coursework with practical applications in real-world settings. Through sustained engagement with industry or research environments, students gain exposure to current technologies, methodologies, and workflows.

The internship also encourages interdisciplinary learning by allowing students to work on problems that span multiple domains, thereby enhancing their analytical and critical thinking abilities.

2.2 Professional Outcomes

In addition to academic learning, the internship program aims to develop essential professional competencies. Students are expected to understand workplace expectations, adhere to organizational norms, and demonstrate effective communication in professional settings.

The program fosters teamwork, leadership, time management, and problem-solving skills, all of which are critical for career success. Students also gain insights into corporate culture, professional ethics, and industry practices.

2.3 Mapping to Program Outcomes

The internship contributes directly to key Program Outcomes (POs) defined under Outcome-Based Education (OBE). These include:

- Application of engineering knowledge (PO1)
- Problem analysis and solution design (PO2)
- Understanding of professional ethics (PO8)
- Ability to work in teams (PO9)
- Effective communication skills (PO10)

This mapping ensures that the internship is not an isolated activity but an integral part of the academic framework.

3. REGULATORY ALIGNMENT

The internship framework at VESIT is designed in alignment with national educational and accreditation guidelines.

The **AICTE Internship Policy** emphasizes structured internships, faculty mentoring, industry evaluation, and documentation, all of which are incorporated into this handbook.

The **National Education Policy (NEP 2020)** advocates experiential learning and industry integration, which is reflected in the mandatory six-month internship structure.

The **NBA framework** requires outcome-based evaluation and continuous assessment, which is achieved through multi-source evaluation methods.

The **NAAC guidelines** emphasize governance, transparency, and documentation, all of which are ensured through the centralized T&P system and departmental record-keeping.

4. ACADEMIC STRUCTURE

The internship program is conducted over a continuous period of **six months**, typically from January to June, and carries approximately **12 academic credits**. This duration ensures that students gain meaningful exposure and are able to contribute effectively within their assigned roles.

Students are required to complete a minimum of **360 working hours**, ensuring that the internship is substantive and not merely observational.

Internships may be undertaken in a variety of settings, including industry organizations, research institutions, startups, government bodies, and non-governmental organizations. In cases where external opportunities are not available, students may be assigned structured in-house internships under faculty supervision.

Eligibility for internship participation requires students to meet academic criteria, secure a valid internship offer, and obtain approval from both the Training & Placement Cell and the department.

5. INTERNSHIP SOURCES & PLATFORMS

Internship opportunities at VESIT are sourced through multiple channels to ensure accessibility and diversity of options.

The **Training & Placement Cell** serves as the primary source of internships, organizing campus drives and leveraging industry partnerships. These opportunities are verified and aligned with institutional standards.

The institute also benefits from a strong **alumni network**, which plays a significant role in facilitating internship opportunities. Faculty members further contribute through their industry connections and research collaborations.

Students are encouraged to explore **national internship platforms** such as the AICTE Internship Portal, LinkedIn, as well as apply directly through company career portals.

Self-secured internships are permitted but must be approved by the T&P Cell to ensure authenticity, relevance, and compliance with academic requirements.

6. INTERNSHIP LIFECYCLE

The internship process is structured into three phases to ensure systematic execution and monitoring.

During the **pre-internship phase**, students are required to register with the T&P Cell, submit internship details, and obtain necessary approvals. Faculty mentors are assigned at this stage.

During the **internship phase**, students maintain logbooks, submit periodic updates, and participate in reviews. Faculty mentors and departments monitor progress, while the T&P Cell tracks overall participation.

In the **post-internship phase**, students submit all required documents, including reports and evaluation forms, and appear for viva. Departments conduct evaluation, and T&P ensures compliance.

7. INTERNSHIP-CUM-PLACEMENT PARTICIPATION POLICY

7.1 Policy Objectives and Framework

The Internship-cum-Placement Participation Policy at VESIT is designed to ensure a fair, transparent, and structured approach to student participation in internships and placement opportunities. The policy is formulated to balance student aspirations with institutional responsibility while maintaining strong and ethical relationships with recruiters.

In alignment with institutional goals and national educational frameworks, the policy ensures equitable opportunity distribution, prevents misuse of the placement process, and enforces disciplined participation among students. It also supports the structured integration of internships with placement pathways, ensuring that students make informed and accountable career decisions.

7.2 Core Principles Governing Participation

The policy is governed by a set of foundational principles that define the permissible limits and behavior of students during internship and placement processes.

Each student is permitted to accept **only one internship offer**, and once accepted, the internship is considered final and binding. Students are strictly prohibited from participating in additional internship opportunities or attempting to switch internships under any circumstances. This ensures fairness and prevents multiple students from being deprived of opportunities.

In addition to internship restrictions, the policy enforces a **maximum limit of two offers per student**, which may include a combination of internship and full-time employment (FTE) offers. This structured limit ensures controlled participation and prevents excessive offer accumulation.

Students receiving a **Pre-Placement Offer (PPO)** as a result of internship performance are considered **provisionally placed**. However, a controlled pathway is provided for academic and career advancement through participation in select FTE opportunities under defined conditions.

7.3 Internship Participation Rules

Students are allowed to participate in internship opportunities through the Training & Placement Cell or through approved self-secured channels. However, once a student accepts an internship offer:

- The student is immediately withdrawn from all further internship processes

- No switching, withdrawal, or renegotiation is permitted
- The accepted internship is treated as the student's sole internship engagement

This strict enforcement ensures discipline, maintains institutional credibility with recruiters, and guarantees equitable distribution of opportunities among students.

7.4 Internship Outcomes and PPO Policy

Internships may result in two primary outcomes: with PPO or without PPO.

7.4.1 Internship with PPO

When a student receives a PPO (either confirmed or conditional), the student is considered **provisionally placed**. This reflects the organization's intent to offer full-time employment based on internship performance.

However, students are permitted a **controlled upgrade pathway**, subject to strict conditions:

- The student may participate **only in Full-Time Employment (FTE) opportunities**
- Participation in further internships is strictly prohibited
- The **2× CTC rule must be satisfied**
- The original company must permit participation in further processes
- The PPO (conversion) CTC is treated as the **first offer benchmark**

This ensures that students have the opportunity to pursue better roles while maintaining fairness and recruiter trust.

7.4.2 Internship without PPO

If an internship does not result in a PPO, the student remains eligible for placement participation under defined conditions:

- The student is **not allowed to apply for another internship**
- The student may participate in FTE placement opportunities
- The student may accept **only one FTE offer**

This ensures that students continue to receive placement support while maintaining structured participation limits.

7.5 Full-Time Employment (FTE) Participation Rules

Students participating in placement processes are governed by strict FTE acceptance rules.

A student may accept only **one FTE offer**, upon which the student is considered placed and must exit all further placement processes. The only exception to this rule is participation in a **controlled upgrade opportunity** as defined under the 2× rule.

The FTE offer represents a formal employment commitment and must be treated with seriousness and accountability. Students are expected to honor their acceptance and avoid withdrawal or renegotiation.

7.6 Second Offer (Upgrade) Policy – 2× Rule

The upgrade policy allows high-performing students to pursue better opportunities while maintaining structured control over placement participation.

An upgrade (second offer) is permitted only if:

- The second offer provides a **minimum of 2× the CTC** of the first offer
- The first company explicitly allows participation in further processes

The determination of CTC for comparison follows defined rules:

- Internship with PPO → PPO conversion CTC is considered
- Internship without PPO → benchmark CTC is applied
- FTE → actual CTC is considered

Only **one upgrade opportunity** is permitted, and once accepted, the second offer becomes final. No further participation is allowed thereafter.

7.7 Company Restrictions and Ethical Considerations

The policy respects company-specific restrictions. If the first company explicitly prohibits participation in further recruitment processes, the student is not permitted to seek an upgrade, irrespective of the 2× condition.

This ensures that institutional relationships with recruiters are preserved and that commitments made by students are honored.

7.8 Offer Limit Framework

The policy enforces a strict maximum of **two offers per student**, which may include combinations such as:

- Internship + FTE
- Internship (with PPO) + FTE upgrade

- FTE + upgrade
- FTE + internship (only in NO-PPO cases)

This framework ensures structured flexibility while preventing excessive offer accumulation.

7.9 Transparency and Disclosure Requirements

All students are required to maintain complete transparency in their internship and placement activities. Any offer, whether secured through campus processes or independently, must be reported to the Training & Placement Cell.

Failure to disclose offers is considered a serious violation and may lead to disciplinary action. This ensures fairness and accurate tracking of student participation.

8. INTERNSHIP COMPLETION, VALIDATION AND ACADEMIC COMPLIANCE

The internship component at VESIT is designed primarily as an experiential and industry-integrated academic engagement. Since students may undergo internships across diverse domains, organizations, technologies, and work environments, a uniform centralized marks-based evaluation framework may not always ensure fairness and consistency.

Accordingly, the institute adopts a **completion and compliance-based validation approach** for external internships, focusing on authenticity, participation, learning engagement, and successful completion of assigned responsibilities.

The purpose of this framework is to ensure that students meaningfully participate in the internship process while maintaining academic accountability, documentation integrity, and professional discipline.

8.1 Internship Completion Requirements

To successfully complete the internship component, students must fulfill all mandatory academic and administrative requirements prescribed by the institute.

Every student must:

- Successfully complete the approved internship duration
- Adhere to the policies and guidelines of both the organization and the institute

- Maintain professional conduct throughout the internship period
- Submit all mandatory internship documents within prescribed timelines

The internship shall be considered valid only after successful verification and approval by the department and Training & Placement Cell.

8.2 Mandatory Submission Requirements

Students are required to submit the following documents after completion of the internship:

Mandatory Documents

- Internship Completion Certificate issued by the organization
- Internship Offer Letter
- Student Internship Report
- Weekly / Periodic Logbook (if prescribed)
- Student Feedback Form
- Industry Feedback / Evaluation Form (if available)

The internship completion certificate must clearly mention:

- Student name
- Organization name
- Internship duration
- Nature of work / role performed
- Authorized signatory details

The institute reserves the right to verify the authenticity of all submitted documents.

8.3 Role of Internship Completion Certificate

The Internship Completion Certificate is considered the **primary validation document** for successful completion of the internship.

The certificate serves as official confirmation that:

- The student has completed the internship successfully
- The student has fulfilled assigned responsibilities
- The organization acknowledges the student's participation

Submission of the completion certificate is mandatory for academic recognition of the internship.

Failure to submit the certificate may result in:

- Non-acceptance of internship completion
- Requirement for additional academic work
- Delay in result processing or credit award

8.4 Academic Documentation and Review

Although the internship is industry-driven, students are expected to maintain academic engagement throughout the internship period.

Departments may require students to submit:

- Internship report
- Logbook / weekly activity summary
- Progress updates
- Presentation or seminar

These activities are intended to ensure that students are able to:

- Reflect on their learning experience
- Relate industry work to academic concepts
- Develop technical documentation and communication skills

Departments may conduct review meetings or interactions during the internship period to monitor student progress and ensure continuous engagement.

8.5 Internship Presentation / Viva (Departmental Requirement)

Departments may conduct a final presentation, seminar, or viva voce at the end of the internship period as part of academic documentation and learning validation.

The presentation may include:

- Overview of organization and work domain
- Nature of project or tasks performed
- Technologies and tools used
- Key learning outcomes

- Challenges faced and solutions implemented

The objective of the presentation is not merely assessment but also:

- Knowledge sharing
- Reflection on experiential learning
- Communication skill development

8.6 In-House Internship Evaluation Framework

For students undertaking **in-house internships**, a more structured academic evaluation mechanism may be adopted since the internship is conducted under direct faculty supervision.

Departments may evaluate in-house internships based on:

- Project progress and milestone completion
- Technical implementation and innovation
- Documentation quality
- Participation in review meetings
- Final report and presentation

Suggested components for in-house internship assessment may include:

Component	Suggested Weightage
Project Work & Implementation	40%
Documentation / Report	20%
Periodic Reviews	20%
Final Presentation / Viva	20%

Departments may modify the structure based on academic requirements and project nature.

8.7 Attendance and Participation Requirements

Students are expected to maintain active participation throughout the internship duration.

For external internships:

- Attendance and engagement shall primarily be validated through the completion certificate and organization confirmation.

For in-house internships:

- Attendance and participation shall be monitored directly by the department and faculty mentor.

Excessive absenteeism, non-participation, or failure to engage meaningfully may lead to rejection or non-completion status.

8.8 Non-Completion / Incomplete Internship Cases

The internship may be considered incomplete if:

- The student fails to complete the required duration
- Mandatory documents are not submitted
- The internship is terminated due to misconduct or poor performance
- Submitted documents are found to be fake or unverifiable

In such cases, the institute may:

- Require the student to undertake additional academic work
- Assign an alternative in-house internship/project
- Delay academic completion until requirements are fulfilled

8.9 Institutional Validation and Final Approval

The final approval of internship completion shall be jointly processed by:

- Department Internship In-Charge
- Faculty Mentor
- Training & Placement Cell

The approval process ensures:

- Authenticity of internship
- Compliance with institutional policy
- Completion of academic requirements

Only after successful validation shall the internship credits/status be processed.

9. INTERNSHIP ADMINISTRATION AND COORDINATION FRAMEWORK

The Internship Administration and Coordination Framework of the internship program follows a centralized model led by the Training & Placement Cell.

The **T&P Cell**, headed by the Training & Placement Officer (TPO) and Deputy TPO, is responsible for approvals, coordination, and policy enforcement.

Each department has an **Internship In-Charge and Placement In-Charge**, who coordinate activities at the departmental level. Faculty mentors provide academic guidance and evaluation.

Students are responsible for compliance, documentation, and professional conduct.

10. DOCUMENT MANAGEENT SYSTEM

10.1 Document Lifecycle

The internship program at VESIT follows a structured and well-defined document lifecycle to ensure transparency, traceability, and compliance with institutional and accreditation requirements. Documentation begins at the pre-internship stage and continues through the internship period until final evaluation and record archival.

In the pre-internship phase, students are required to submit essential documents such as the internship registration form, offer letter, job description, and undertaking. These documents are verified by the Training & Placement Cell/Internship Incharge to ensure that the internship opportunity is authentic, relevant to the student's academic program, and aligned with institutional guidelines.

During the internship, continuous documentation is maintained through weekly logbooks, monthly progress reports, and communication records. These documents serve as evidence of the student's engagement, work performed, and skills acquired.

In the post-internship phase, students must submit final documentation including the internship completion certificate, industry evaluation form, final report, and logbook. These documents are verified by the department and recorded by the Department Internship in charge for future reference and audit purposes.

10.2 Responsibility Matrix

The document management system operates on a dual-layer responsibility framework to ensure clarity and accountability.

Internship In charges are responsible for maintaining records of all internship-related activities, including student registrations, approvals, offers, and compliance status. It ensures that all data is accurately recorded and readily available for institutional review and accreditation audits.

Departments are responsible for maintaining academic documents such as logbooks, reports, evaluation sheets, and attendance records. They also verify the authenticity and completeness of student submissions.

Faculty mentors play a crucial role in validating academic progress, reviewing documentation, and providing feedback. Students, on their part, are responsible for timely submission and accuracy of all required documents.

This structured approach ensures that responsibilities are clearly defined and that no stage of documentation is overlooked.

10.3 Record Retention

All internship-related documents must be preserved systematically for a minimum period of three to five years. This is essential for compliance with accreditation bodies such as NBA and NAAC, which require documented evidence of academic processes and student outcomes.

Records should be maintained in both physical and digital formats. Departments are responsible for maintaining academic records. Proper indexing and categorization of documents must be ensured to facilitate easy retrieval during audits.

11. STANDARD OPERATING PROCEDURES (SOPs)

The Standard Operating Procedures (SOPs) define the structured academic and documentation requirements that every student must follow during the internship. These procedures ensure consistency, quality of learning, and uniform evaluation across departments. They also serve as a mechanism to track student engagement, validate learning outcomes, and maintain institutional accountability.

11.1 Logbook Guidelines

The internship logbook is a **mandatory academic document** that serves as a continuous record of the student’s activities, learning progression, and professional engagement throughout the internship period. It acts as primary evidence of work performed and plays a critical role in evaluation and academic assessment.

Students are required to maintain a **weekly logbook**, either in prescribed physical format or approved digital format, capturing structured details of their internship experience.

Each logbook entry must include:

- Description of tasks assigned and completed during the week
- Technical concepts, tools, or technologies learned
- Challenges encountered and approaches taken to resolve them
- Observations related to organizational processes, workflows, or systems
- Reflection on learning outcomes and their relevance to academic concepts

The logbook should not be a mere listing of activities but must reflect **analytical thinking, problem-solving ability, and knowledge application**. Students are expected to demonstrate how their work contributes to their academic development and professional growth.

Review and Validation Process

The logbook must undergo periodic verification:

- **Faculty Mentor**: Assesses academic relevance and learning outcomes

At least **two formal reviews** shall be conducted during the internship period. The logbook must be signed/approved after each review.

Compliance Requirements

- Logbook must be updated regularly (weekly basis)
- Backdated or bulk entries are not permitted
- Incomplete or poorly maintained logbooks may result in penalty or rejection

11.2 Internship Report Guidelines

The internship report is a **formal academic document** that provides a comprehensive account of the student's internship experience, technical contributions, and learning outcomes. It reflects the student's ability to document, analyze, and present professional work in an academic format.

The report must be structured systematically and adhere to prescribed formatting and academic standards.

Suggested Report Structure

1. **Title Page**
2. **Certificate / Declaration**
3. **Acknowledgement**
4. **Abstract / Executive Summary**

5. **Introduction to Organization**
6. **Problem Statement / Objectives**
7. **Scope of Work**
8. **Methodology / Approach**
9. **Technical Work Description**
10. **Tools, Technologies, and Frameworks Used**
11. **Results and Analysis**
12. **Challenges Faced and Solutions Implemented**
13. **Learning Outcomes and Skill Development**
14. **Conclusion and Future Scope**
15. **References / Bibliography**
16. **Appendices (if any)**

The report must clearly demonstrate:

- Application of theoretical concepts in practical scenarios
- Depth of technical understanding
- Problem-solving and analytical capability
- Professional documentation skills

Academic Integrity and Quality Standards

Students must ensure that:

- The report is **original and plagiarism-free**
- Proper referencing (APA/IEEE or prescribed format) is followed
- Content is well-structured, coherent, and technically accurate

Reports will be evaluated based on:

- Technical depth and clarity
- Relevance to academic domain
- Quality of analysis and documentation
- Presentation and formatting

Failure to meet academic standards may result in revision requirements or evaluation penalties.

11.3 Presentation and Viva Voce Guidelines

The final stage of internship assessment involves a **formal presentation and viva voce examination**, which evaluates the student's understanding, communication ability, and overall internship learning.

Presentation Requirements

Students must prepare a structured presentation (typically 10–15 slides) covering:

- Overview of organization and role
- Problem statement and objectives
- Work undertaken and technical contributions
- Tools and technologies used
- Results, achievements, and impact
- Key learning outcomes

The presentation should be:

- Clear and concise
- Technically accurate
- Professionally designed
- Time-bound (typically 10–15 minutes)

Viva Voce Evaluation

The viva voce is conducted by a panel of faculty members and focuses on:

- Conceptual understanding of work performed
- Depth of technical knowledge
- Ability to justify approaches and decisions
- Problem-solving capability
- Awareness of industry practices

Students may also be asked questions related to:

- Core subjects relevant to their internship
- Tools and technologies used
- Practical challenges and solutions

12. PROFESSIONAL CONDUCT & COMPLIANCE

The internship at VESIT is not only an academic requirement but also a **professional engagement representing both the student and the institution**. Therefore, students are expected to maintain the highest standards of discipline, ethics, and responsibility throughout the internship period.

This section defines the behavioral expectations, compliance requirements, and disciplinary framework to ensure that students conduct themselves in a manner consistent with industry standards and institutional values.

12.1 Code of Conduct

Students must demonstrate **professional integrity, accountability, and ethical behavior** at all times during the internship. As representatives of the institute, their conduct directly impacts the institution's reputation and its relationship with industry partners.

Students are required to:

- Adhere strictly to the **policies, rules, and code of conduct** of the host organization
- Maintain **professional discipline**, including punctuality, regular attendance, and timely completion of assigned tasks
- Demonstrate **respectful behavior** towards supervisors, colleagues, and all stakeholders in the organization
- Follow **organizational hierarchy and communication protocols**
- Maintain **confidentiality of organizational data**, proprietary information, and intellectual property
- Comply with **Non-Disclosure Agreements (NDAs)** or any contractual obligations imposed by the organization
- Use organizational resources (systems, data, tools) **responsibly and ethically**
- Avoid any form of misconduct, including harassment, discrimination, or unprofessional communication

Students must also ensure that:

- They **do not misrepresent their role, qualifications, or work**
- They **do not engage in parallel employment or conflicting commitments** during the internship period
- They comply with **all safety, legal, and operational guidelines** of the organization

Any deviation from expected professional behavior will be treated as a serious violation.

12.2 Attendance, Working Hours, and Leave Policy

Internship participation requires **full-time engagement**, and students are expected to adhere strictly to the working hours and attendance policies of the host organization.

Students must:

- Follow the **daily working hours and schedule** defined by the organization

- Maintain **regular and consistent attendance** throughout the internship period
- Inform both the **industry supervisor and faculty mentor** in case of any absence

Leave Policy

- Leave must be **formally approved** by the organization
- Students must also inform and obtain concurrence from the **faculty mentor/department**
- Leaves should be limited to **genuine and unavoidable circumstances**

Institute Requirements During Internship

Students may be required to:

- Attend **mandatory review meetings at the institute**
- Be present for **academic submissions, viva, and examinations**

Organizations are expected to permit such academic participation, and students must plan accordingly.

Consequences of Non-Compliance

- Unauthorized absence or excessive leave may result in:
    - Reduction in evaluation marks
    - Negative feedback from the organization
    - Rejection or invalidation of internship

12.3 Academic and Professional Integrity

Students must maintain **strict academic and professional integrity** throughout the internship.

This includes:

- Submission of **genuine and verifiable internship documents**
- Preparation of **original internship reports**
- Accurate representation of work performed
- Proper citation and referencing in reports

Students must **not**:

- Submit **fake offer letters or certificates**
- Plagiarize content in reports or presentations
- Falsify logbook entries or work records

- Misrepresent their contributions

The institute enforces a **zero-tolerance policy toward academic dishonesty**.

12.4 Transparency and Disclosure Requirements

Students are required to maintain **complete transparency** with the Training & Placement Cell and the department regarding all internship and placement-related activities.

This includes:

- Reporting all internship offers (campus or self-secured)
- Declaring PPO status (confirmed/conditional)
- Disclosing all placement offers

Non-disclosure is considered a **serious policy violation**, as it disrupts fair opportunity distribution and institutional tracking mechanisms.

12.5 Workplace Conduct and Behavioral Expectations

Students must conduct themselves in a manner consistent with professional workplace standards. This includes:

- Maintaining **formal and respectful communication**
- Demonstrating **teamwork and collaboration**
- Accepting feedback positively and improving performance
- Managing time effectively and meeting deadlines

Students must avoid:

- Unprofessional behavior (lateness, negligence, inappropriate communication)
- Conflicts or disputes within the organization
- Unauthorized sharing of company information

12.6 Violations and Disciplinary Actions

Any violation of internship, placement, or conduct guidelines will be treated with seriousness and may result in disciplinary action.

Types of Violations

- Submission of fake or forged documents
- Plagiarism in reports or presentations
- Non-disclosure of internship or placement offers

- Violation of internship participation rules (e.g., multiple internships)
- Breach of company policies or misconduct at workplace
- Violation of placement policy (offer misuse, withdrawal without approval)

Disciplinary Actions

Depending on the severity of the violation, the following actions may be taken:

- Cancellation of internship or evaluation
- Award of "Fail" grade in internship
- Debarment from placement processes
- Withdrawal of placement support
- Reporting to disciplinary committee for further action

12.7 Institutional Zero-Tolerance Policy

VESIT maintains a **zero-tolerance policy** towards academic dishonesty, professional misconduct, and policy violations.

Students are expected to act with integrity, responsibility, and accountability at all times. Any action that compromises institutional values or industry relationships will be addressed strictly.

12.8 Ethical and Professional Responsibility

The internship is an opportunity for students to develop not only technical skills but also **ethical judgment and professional maturity**. Students are expected to:

- Uphold ethical standards in all professional interactions
- Respect diversity and inclusivity in the workplace
- Demonstrate responsibility towards assigned tasks and commitments

The institute expects every student to represent VESIT as a **responsible and ethical professional**.

13. SPECIAL CASES

While the internship program at VESIT is designed to follow a structured and standardized process, certain situations require controlled flexibility. This section defines the guidelines, expectations, and approval mechanisms for such special cases to ensure that academic rigor, fairness, and institutional compliance are maintained at all times.

All special cases must be **formally reviewed and approved by the Training & Placement (T&P) Cell in coordination with the respective department**, and no exception shall be considered valid without documented approval.

13.1 Self-Secured Internships

Students are encouraged to take initiative in exploring and securing internship opportunities independently through professional networks, online platforms, research collaborations, or direct applications to organizations. Such self-secured internships promote proactive learning and industry engagement; however, they must adhere strictly to institutional guidelines.

Approval Requirements

Before joining a self-secured internship, students must obtain formal approval from the T&P Cell. The approval process ensures that the internship is:

- **Authentic and verifiable** (legitimate organization with traceable details)
- **Relevant to the student's academic program and domain**
- **Structured with defined roles, responsibilities, and deliverables**
- **Compliant with internship duration and engagement requirements**

Students must submit the following documents for approval:

- Official offer letter on company letterhead
- Detailed job description / role description
- Company profile (including website and contact details)
- Internship duration and working hours
- PPO status (Yes/No/Conditional)

Verification and Validation

The T&P Cell reserves the right to:

- Verify the authenticity of the organization and offer
- Contact the organization for confirmation
- Reject internships that are found to be:
    - Non-technical or irrelevant
    - Unstructured or lacking defined responsibilities
    - Suspicious, fraudulent, or unverifiable

Policy Applicability

Once approved, self-secured internships are treated **equivalent to T&P-facilitated internships**, and all rules apply:

- One Student – One Internship rule
- No switching or withdrawal
- Internship-cum-placement policy (Section 7)

Failure to obtain approval prior to joining will result in the internship being **considered invalid**.

13.2 In-House Internship

In-house internships are designed as an academic alternative for students who are unable to secure external internships through campus or self-secured means. These internships are conducted within the institute under the supervision of faculty members and must maintain the same level of academic rigor and professional structure as external internships.

Structure and Nature of Work

In-house internships must involve:

- **Structured project work** aligned with the student's academic domain
- Clearly defined **problem statements and objectives**
- Use of relevant **tools, technologies, and methodologies**
- Measurable **deliverables and outcomes**

The work assigned must simulate real-world scenarios to the extent possible and should not be limited to theoretical or superficial tasks.

Supervision and Monitoring

Each student will be assigned a **faculty mentor** who will:

- Define project scope and milestones
- Monitor progress through periodic reviews
- Evaluate technical depth and learning outcomes

Departments must ensure that:

- Regular review meetings are conducted
- Progress is documented and tracked
- Academic standards are maintained

Compliance Requirements

Students undertaking in-house internships must comply with:

- Logbook maintenance
- Report submission
- Presentation and viva

These internships are evaluated using the same criteria as external internships to ensure uniformity and fairness.

13.3 No Internship Scenario (Exceptional Cases)

In rare and exceptional cases where a student is unable to secure an internship despite participating in all available opportunities and fulfilling eligibility requirements, the institute provides a structured academic alternative to ensure that the student is not academically disadvantaged.

Alternative Academic Engagement

Students in this category will be assigned a **mandatory in-house academic project or equivalent structured activity**, which may include:

- Research-based projects
- Industry-simulated problem statements
- Interdisciplinary innovation projects

The assigned work must:

- Match the **academic credits of the internship**
- Follow the same **duration and workload requirements**
- Be evaluated using the same **assessment framework**

Evaluation and Outcome

The alternative academic work will be evaluated based on:

- Technical depth and originality
- Problem-solving approach
- Documentation and presentation

Successful completion will be treated as equivalent to internship completion for academic purposes.

13.4 Transition Between Special Cases

Movement between categories (e.g., from self-secured internship to in-house or vice versa) is **not permitted once an option is approved and commenced**, except under exceptional circumstances approved by the institute.

14. SCENARIO-BASED INTERPRETATION

To ensure uniform implementation of the Internship-cum-Placement Policy and eliminate ambiguity, a structured scenario-based interpretation framework is established. This framework provides clarity on permissible actions, restrictions, and outcomes under different combinations of internship and placement situations.

Each scenario must be interpreted in conjunction with **Section 7 (Policy Rules)**, and decisions shall be governed strictly by defined conditions.

14.1 Internship with PPO (Provisional Placement Case)

When a student secures an internship that includes a Pre-Placement Offer (PPO), either confirmed or conditional, the student is considered **provisionally placed**. This indicates the organization's intent to convert the internship into full-time employment.

In such cases:

- The student is **not permitted to participate in any further internship opportunities**
- The student may participate **only in Full-Time Employment (FTE) opportunities** for the purpose of upgrade
- The upgrade is permitted strictly under:
    - Satisfaction of the **2× CTC rule**
    - Explicit permission from the first company

The PPO (conversion) CTC is treated as the **first offer benchmark** for all upgrade decisions.

14.2 Internship without PPO → FTE Participation

When a student completes an internship that does not offer a PPO, the student remains **unplaced** and is eligible to participate in campus placement processes.

In such cases:

- The internship is treated as the **first offer (academic engagement)**
- The student is eligible to apply for **FTE opportunities only**
- The student may accept **only one FTE offer**, after which:

- The student is considered placed
- Further participation is not allowed

No second internship is permitted under any circumstances.

14.3 Attempt to Accept Multiple Internships (Violation Case)

If a student, after accepting an internship, attempts to apply for or accept another internship:

- This constitutes a violation of the **“One Student – One Internship” rule**
- Such applications shall be **blocked at the T&P level**
- Repeated or intentional violations may result in **disciplinary action or debarment**

14.4 Valid Upgrade Scenario (2× Rule Applied)

A student may pursue an upgrade (second offer) only when:

- The second offer provides **at least twice (≥ 2×) the CTC** of the first offer
- The first company allows further participation

Outcome:

- The second offer becomes the **final offer**
- The student must **exit all placement processes immediately**

14.5 Invalid Upgrade Scenario (Below 2×)

If the second offer does not meet the 2× compensation requirement:

- The upgrade is **not permitted**
- The student must retain the first offer
- Participation in such processes may be restricted or blocked

14.6 Company Restriction Scenario

If the first company explicitly restricts the student from participating in further recruitment processes:

- The student is **not eligible for upgrade**, irrespective of the 2× condition
- The first offer remains binding

14.7 Self-Secured Internship Scenario

If a student secures an internship independently:

- It is treated as a **regular internship under policy**
- All rules apply:
    - One internship limit
    - Placement participation rules
- Approval from T&P is mandatory

14.8 Self-Secured FTE Scenario

If a student secures a full-time job independently before or during campus placement:

- It is treated as the **first offer**
- The student may be eligible for upgrade under the **2× rule**, subject to:
    - Disclosure to T&P
    - Company permissions

14.9 FTE First → Internship (NO PPO Case)

If a student secures an FTE offer first and later applies for an internship:

- The internship must be clearly declared as **NO-PPO (no conversion)**
- The internship is treated as an **academic requirement only**

Outcome:

- Allowed
- Counts as second offer
- FTE remains final placement

14.10 FTE First → Internship WITH PPO (Not Allowed)

If an internship includes a PPO possibility:

- It creates a conflict with the existing FTE
- Such participation is **strictly not permitted**

14.11 Ambiguous Internship (Conditional PPO Case)

If a company indicates that PPO is “performance-based”:

- It is treated as a **PPO-possible case**
- Not allowed for students with existing FTE

Students must obtain written clarification if claiming NO-PPO.

14.12 No PPO + No FTE (Unplaced Case)

If a student completes internship without PPO and does not secure FTE:

- The student remains **unplaced**
- The T&P Cell continues to provide **placement support post internship period**

14.13 Non-Disclosure of Offer (Serious Violation)

If a student fails to disclose any internship or placement offer:

- It is treated as a **major policy violation**
- May result in:
  - Debarment from placement
  - Disciplinary action

14.14 Exceeding Offer Limit

If a student attempts to secure more than two offers:

- The system will block participation
- Any additional offer is **invalid**

14.15 Internship → FTE → Upgrade Attempt Beyond Limit

If a student already holds two offers:

- Further upgrade attempts are **not allowed**
- The student must exit all processes.

15. CHECKLISTS

To ensure smooth execution and compliance, structured checklists are defined for each stage of the internship lifecycle.

15.1 Pre-Internship Checklist

Students must:

- Register with T&P
- Submit offer letter and details
- Declare PPO status
- Obtain approval from T&P and department
- Confirm faculty mentor allocation

Departments must:

- Verify student eligibility
- Assign mentor
- Maintain record

T&P/ Internship Incharge must:

- Approve internship
- Update central tracker

15.2 During Internship Checklist

Students must:

- Maintain weekly logbook
- Participate in reviews
- Communicate regularly with mentor

Departments must:

- Conduct periodic reviews
- Monitor progress

T&P /Internship In charge must:

- Track participation and compliance

15.3 Post-Internship Checklist

Students must:

- Submit:
    - Completion certificate
    - Logbook
    - Report
    - Evaluation forms
- Appear for viva

Departments must:

- Evaluate and record marks

T&P/Internship Incharge must:

- Update final status

16. GLOSSARY OF TERMS

To ensure clarity, the following key terms are defined:

- **Internship**: Structured work experience forming part of academic curriculum
- **PPO (Pre-Placement Offer)**: Job offer given based on internship performance
- **FTE (Full-Time Employment)**: Permanent employment offer
- **CTC (Cost to Company)**: Total compensation package offered by employer
- **Upgrade (Second Offer)**: Higher offer meeting defined policy conditions
- **2× Rule**: Second offer must be at least twice the first offer
- **Logbook**: Weekly record of internship activities
- **Viva Voce**: Oral examination conducted for evaluation
- **Faculty Mentor**: Academic guide assigned to student
- **Internship In-Charge**: Department coordinator for internship

17. INTERNSHIP/PLACEMENT PARTICIPATION SUMMARY

The internship policy at VESIT is designed to ensure fairness, discipline, and structured participation.

Key principles include:

- One student → One internship
- Maximum two offers
- No internship switching
- PPO → provisional placement
- Upgrade allowed only under **2× rule**
- Mandatory disclosure of all offers

The policy ensures:

- Equal opportunity distribution
- Strong industry relationships
- Transparent and accountable processes

Students are expected to understand and strictly adhere to these rules.

18. ANNEXURES (DETAILED TEMPLATES)*** In process

Annexure A – Internship Registration Form

Annexure B – Weekly Logbook Format

Annexure D – Faculty Evaluation Form

Annexure E – Student Undertaking

Annexure F – Internship Completion Certificate

Annexure G – Attendance Sheet(Inhouse)

Syllabus of Dual Minor Domain Courses*

offered by

ECS Department

(To all the students from B.Tech. Sem-V to Sem-VIII)

*Edge Computing and Embedded Intelligence

A.Y. 2026-27

Course Type	Semester V to VIII Teaching Scheme (AY 2026-27)								
	Course Code	Course Name	Teaching Scheme (Contact hours)			Credits Assigned			
			TH	PR	TUT	TH	PR	TUT	Total
MEA	26ECMEA51/ 26ECMEAL51	Applied AI for Engineering Systems	3	2	---	3	1	---	4
MEA	26ECMEA61/ 26ECMEAL61	Intelligent Systems & Real-world AI Applications	3	4	---	3	2	---	5
MEA	26ECMEA71/ 26ECMEAL71	Edge AI & Embedded Intelligence (Theory)	3	4	---	3	2	---	5
MEA	26ECMEA81	NPTEL COURSE	---	---	---	---	---	---	4
	Total Credits								**18**

Course Type	Semester V to VIII Examination Scheme							
	Course Code	Course Name	TH	MT	CA	TW	PR/ OR	Total
MEA	26ECMEA51/ 26ECMEAL51	Applied AI for Engineering Systems	60	20	20	25	25	150
MEA	26ECMEA61/ 26ECMEAL61	Intelligent Systems & Real-world AI Applications	60	20	20	25	25	150
MEA	26ECMEA71/ 26ECMEAL71	Edge AI & Embedded Intelligence (Theory)	60	20	20	25	25	150
MEA	26ECMEA81	NPTEL COURSE	---	---	---	---	---	100
	Total Marks							**550**

Applied AI for Engineering Systems								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECMEA51	Applied AI for Engineering Systems (Theory)	03	--	--	03	--	--	03
26ECMEAL51	Applied AI for Engineering Systems (Lab)	--	02	--	--	01	--	01
							Total Credits	**04**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Prerequisite: Bridge course of 1 week	
1	What is AI/ML?
2	Supervised vs Unsupervised Learning
3	Python ,Google Colab basics
4	Visual demos of ML models
5	Introduction to datasets
Course Objectives:	
1	Understand the foundational role of Artificial Intelligence in solving engineering and real-world problems.
2	Develop skills in handling datasets including cleaning, preprocessing, and feature engineering.
3	Apply pre-trained machine learning and deep learning models using platforms like Hugging Face and TensorFlow Hub.
4	Explore deployment methods using REST APIs and web interfaces.
5	Analyze and interpret AI model performance using evaluation metrics.
6	Reflect on responsible AI principles including fairness, bias, explainability, and ethical usage in engineering domains.

Course Outcomes: After successful completion of the course students will be able :	
1	Identify engineering use-cases where AI can enhance decision-making or automation.
2	Perform data preprocessing tasks (e.g., cleaning, encoding, feature scaling, and selection) for machine learning pipelines.
3	Access and use pre-trained AI models via APIs for text, image, and sensor data applications.
4	Evaluate AI models using metrics such as accuracy, precision, recall, F1-score, and ROC-AUC.
5	Apply explainability tools such as SHAP and LIME to interpret model behavior in simple scenarios.
6	Build and present a small-scale intelligent system integrating AI components with real-world datasets.

Module		**Theory Course Contents**	**Hrs**
1		**Applied AI in Engineering**	**7**
	1.1	Predictive maintenance, quality inspection	
	1.2	AI Solution Design Lifecycle in Engineering Systems - Problem Formulation in Engineering Domains, Data-to-Deployment Pipeline, tools and Platforms Overview	
2		**Data Pre-processing and Feature Engineering**	**6**
	2.1	Cleaning, encoding, scaling	
	2.2	Feature selection, dimensionality reduction	
3		**Working with Pre-trained Models**	**6**
	3.1	Hugging Face, TensorFlow Hub	
	3.2	REST API via Flask/FastAPI	
4		**Model Evaluation Metrics**	**6**
	4.1	Accuracy, Precision, Recall, F1, ROC, Confusion Matrix deep dive	
5		**Responsible AI Basics**	**6**
	5.1	Bias, Fairness, Explainability (SHAP, LIME)	
	5.2	Ethics, data privacy in IoT/AI systems	
6		**Case Studies**	**8**
	6.1	Smart Attendance System using AI	
	6.2	AI-based Fault Detection in Machines	
	6.3	Energy Consumption Predictor	
		Total	**39**

Textbooks:	
1	Artificial Intelligence – Saroj Kaushik
2	Hands-On Machine Learning with Scikit-Learn, Keras and; TensorFlow – Aurélien Géron
3	Python Machine Learning – Sebastian Raschka
4	Foundations of Machine Learning – Mehryar Mohri, Afshin Rostamizadeh
5	AI for Everyone – Rajiv Mathur
6	Machine Learning Yearning – Andrew Ng
Reference Books:	
1	Pattern Recognition and Machine Learning – Christopher Bishop
2	Explainable AI: Interpreting, Explaining and Visualizing Deep Learning – Ankur Taly et al.
3	Ethics of Artificial Intelligence and Robotics – Stanford Encyclopedia of Philosophy
4	Practical Machine Learning with Python – Dipanjan Sarkar
5	AI and Analytics for Beginners – N. Ramesh Babu
Open-Source Textbooks & Resources:	
1	Machine Learning Yearning – Andrew Ng https://www.deeplearning.ai/machine-learning-yearning/ (Theory-focused guide on designing AI systems)
2	Google's Machine Learning Crash Course https://developers.google.com/machine-learning/crash-course (Beginner-friendly with interactive Python notebooks)
3	FastAI Course – Practical Deep Learning for Coders https://course.fast.ai/ (Project-based deep learning course with code)
4	Dive into Deep Learning – Zhang, Lipton, et al. https://d2l.ai/ (Hands-on DL book with PyTorch/MXNet examples)
5	Google Colab and Hugging Face Tutorials https://colab.research.google.com/ https://huggingface.co/learn (Pre-trained model access and deployment demos)

Applied AI for Engineering LAB

Course Prerequisite: Programming Skills	
Lab Objectives:	
1	To learn data cleaning, encoding, and feature engineering techniques using real-world datasets.
2	To understand model evaluation through metrics and visualization tools like confusion matrices and ROC curves.
3	To gain practical experience in using pre-trained models for image and text classification tasks.
4	To explore AI deployment using REST APIs and create interactive dashboards with tools like Streamlit.
Lab Outcomes: After successful completion of the course students will be able :	
1	Students will preprocess and prepare real-world datasets for effective machine learning.
2	Students will evaluate model accuracy using confusion matrices and ROC analysis.
3	Students will use and deploy pre-trained models for practical AI tasks in image and text.
4	Students will build and demonstrate an end-to-end AI system integrated with interactive interfaces.

Suggested Experiments: Students are required to complete at least 10 experiments.

Sr. No.	Name of the Experiment
1.	Visual dashboard for sensor classification
2.	Clean and preprocess UCI dataset
3.	Confusion matrix for binary classifier
4.	ROC Curve on health dataset
5.	Image classification via MobileNet
6.	Text sentiment using pre-trained model
7.	Feature selection on diabetes dataset
8.	Model serving via REST API
9.	Streamlit demo for interactive AI
10.	Mini project implementation

Intelligent Systems & Real-world AI Applications								
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**			
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECMEA61	Intelligent Systems & Real-world AI Applications (Theory)	03	--	--	03	--	--	03
26ECMEAL61	Intelligent Systems & Real-world AI Applications (Lab)	--	04	--	--	02	--	02
							Total Credits	**05**

Examination Scheme					
Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Objectives:	
1	Understand the key characteristics of intelligent systems and how AI components (text, vision, audio) contribute to system behavior.
2	Learn to apply lightweight AI models (e.g., Decision Trees, KNN, Logistic Regression) for quick, resource-efficient inference.
3	Explore practical applications of computer vision using OpenCV for tasks such as object and face detection.
4	Work with simple audio and text data using pre-trained models for sentiment analysis and keyword spotting.
5	Integrate AI systems with hardware platforms like Raspberry Pi to create smart automation solutions.
6	Develop a real-world project by combining AI pipelines and device integration, fostering hands-on system building.

Course Outcomes: After successful completion of the course, students will be able :	
1	Describe and identify components of an intelligent system that integrates sensor data, logic, and AI inference.
2	Train and apply lightweight machine learning models (e.g., Decision Trees, Logistic Regression) for classification tasks on small datasets.
3	Use OpenCV to implement real-time computer vision features such as object tracking and face detection.
4	Build AI models for text and audio classification (e.g., sentiment detection, voice keyword spotting) using pre-trained models.
5	Connect AI inference with physical device control (e.g., automation using Raspberry Pi GPIOs and actuators).
6	Complete a mini project demonstrating a real-world AI application with hardware integration and present results effectively.

Module		**Theory Course Contents**	**Hrs**
1		**Overview of Intelligent Systems**	**6**
	1.1	Characteristics of Smart Systems: Core traits that drive true system intelligence	
	1.2	Core Components: Combining sensors, logic, and AI (real-world examples from daily life)	
2		**Lightweight AI Models**	**6**
	2.1	Classical Algorithms: Decision Trees, KNN, and Logistic Regression	
	2.2	Efficient Deployment: FastText, MobileNet, and TensorFlow Lite (TFLite) basics	
3		**Computer Vision with OpenCV**	**7**
	3.1	Target Recognition: Face and object detection techniques	
	3.2	Image Processing: Color filtering and edge detection algorithms	
4		**Audio and Text AI**	**6**
	4.1	Text Processing: Sentiment classification	
	4.2	Audio Processing: Keyword spotting and sound analysis	
5		**Device Integration & Automation**	**6**
	5.1	Hardware Interfacing: Raspberry Pi GPIO programming	
	5.2	Physical Computing: Controlling simple relays and actuators via AI triggers	
6		**Case Studies**	**8**
	6.1	AI-based Smart Bin	
	6.2	Voice Activated Switch	
	6.3	Smart Vision Doorbell	
	6.4	Ambient Sound Classifier for Smart Homes	
		Total	**39**

Textbooks:	
1	Artificial Intelligence and Machine Learning – Vinod Chandra
2	Python Projects for Beginners – Connor P. Milliken (Ref)
3	Make Your Own Neural Network – Tariq Rashid
4	Practical AI Projects with Python – Joshua Eckroth
5	Practical AI Projects with Python – Joshua Eckroth
6	Programming Raspberry Pi – Simon Monk
Reference Books:	
1	Smart Systems and AI Applications – Raj Kamal
2	Real World AI – Alexander Ng
3	Computer Vision: Algorithms and Applications – Richard Szeliski
4	Hands-On Python for Machine Learning – Arun Soni
5	Edge AI Projects for Smart Devices – Laurence Moroney
Open-Source Textbooks & Resources:	
1	Make Your Own Neural Network – Tariq Rashid (Free PDF version available on Author's site) http://www.makeyourownneuralnetwork.com/
2	OpenCV-Python Tutorials https://docs.opencv.org/master/d6/d00/tutorial_py_root.html (Real-time computer vision examples with OpenCV)
3	TinyML and Edge AI Projects (Hackster.io) https://www.hackster.io/search?q=tinyml&i=projects (Community projects and demos for students)
4	FastText Sentiment Analysis Tutorial https://fasttext.cc/docs/en/supervised-tutorial.html
5	Audio Processing with Python (PyDub, Librosa) https://librosa.org/doc/latest/index.html

Intelligent Systems & Real-world AI Applications (Lab)

Course Prerequisite: Programming Skills	
Lab Objectives:	
1	To introduce students to lightweight machine learning models for real-world classification tasks.
2	To enable students to apply computer vision and NLP techniques using OpenCV, TFLite, and FastText.
3	To develop understanding of sensor-based automation using Raspberry Pi and AI triggers.
4	To guide students in creating integrated AI systems with real-time inference and output visualization.
Lab Outcomes: After successful completion of the modules, students will be able to:	
1	Build and apply KNN and lightweight models on real-world datasets.
2	Implement face and object detection using computer vision frameworks.
3	Perform sentiment and keyword analysis using pre-trained NLP models.
4	Demonstrate end-to-end intelligent systems integrating AI, hardware, and dashboards.

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1.	Build a KNN classifier on real dataset
2.	Face detection using OpenCV
3.	Object recognition with TFLite
4.	Sentiment analysis using FastText
5.	Keyword detection in audio clips
6.	Raspberry Pi GPIO control
7.	Integrate AI with automation trigger.
8.	Real-time camera AI inference
9.	Build a basic dashboard for output
10.	Mini Project (for 1 credit)

Edge AI & Embedded Intelligence									
Course Code	**Course Name**	**Teaching Scheme** (Hours per week)			**Credits Assigned**				
		TH	**PR**	**Tut**	**TH**	**PR**	**Tut**	**Total**
26ECMEA71	Edge AI & Embedded Intelligence (Theory)	03	--	--	03	--	--	03
26ECMEAL71	Edge AI & Embedded Intelligence (Lab)	--	04	--	--	02	--	02
							Total Credits	**05**

Examination Scheme

Mid Term	**Continuous Assessment**	**End Semester Exam**	**Term Work**	**Practical & Oral**	**Total**
20	20	60	25	25	150

Course Objectives:	
1	Understand the architectural principles and motivations behind Edge AI and TinyML in contrast to cloud-based AI.
2	Explore model compression techniques such as quantization, pruning, and knowledge distillation for deploying models on low-power devices.
3	Gain familiarity with popular edge platforms such as Arduino Nano BLE, ESP32, and Raspberry Pi, including hardware setup and GPIO interfacing.
4	Learn to integrate and collect data from onboard sensors like temperature, accelerometer, and microphones.
5	Deploy optimized AI models on microcontrollers using frameworks like TensorFlow Lite and Edge Impulse.
6	Design and implement a complete end-to-end Edge AI system through a mini project that processes sensor data in real-time..

Course Outcomes:	
After successful completion of the course students will be able :	
1	Explain the differences between Edge AI and Cloud AI in terms of latency, privacy, and power consumption.
2	Apply compression techniques (e.g., quantization, pruning) to prepare AI models for edge deployment.
3	Interface and operate edge hardware platforms (Arduino Nano BLE, ESP32, Raspberry Pi) for AI workflows.
4	Capture and preprocess real-time sensor data from onboard devices for AI-based decision-making.
5	Deploy and test TinyML models on edge platforms using tools like TensorFlow Lite Micro and Edge Impulse.
6	Build and present a working Edge AI mini project that integrates real-world sensor data and embedded intelligence.

Module		**Theory Course Contents**	**Hrs**
1		**Edge AI Fundamentals**	**6**
	1.1	Edge vs Cloud AI	
	1.2	Real-time constraints, privacy	
2		**TinyML Essentials**	**6**
	2.1	Quantization, pruning, distillation	
	2.2	TensorFlow Lite Micro	
3		**Edge Platforms**	**6**
	3.1	Arduino Nano BLE, ESP32, Raspberry Pi	
	3.2	Basic pinout, power, GPIOs	
4		**Model Evaluation Metrics**	**7**
	4.1	Onboard sensors (temperature, accelerometer, mic)	
	4.2	Serial data capture and preprocessing	
5		**Deployment Pipelines**	**7**
	5.1	Edge Impulse, TensorFlow Lite conversion	
	5.2	Inference timing and optimization	
6		**Case Studies**	**7**
	6.1	Smart Farming Sensor Node (soil, temp, humidity + AI)	
	6.2	Wearable Posture Correction Assistant	
	6.3	Voice-Activated Home Automation Node	
		Total	**39**

Textbooks:	
1	AI and IoT for Beginners – N. Ramesh Babu
2	TinyML – Pete Warden and Daniel Situnayake
3	Programming Arduino: Getting Started with Sketches – Simon Monk
4	Raspberry Pi User Guide – Eben Upton and; Gareth Halfacree
5	Edge AI Applications – Ajay Deshmukh
6	Internet of Things: Principles and Paradigms – Rajkumar Buyya
Reference Books:	
1	TinyML Cookbook – Kishore Kumar
2	Designing Embedded Systems with Raspberry Pi – Steven Barrett
3	Hands-On TinyML – Prashant Dandekar
4	ML for Embedded Systems – Matthew Lum
5	IoT and Edge AI Projects – Yasser Shoukry
Open-Source Textbooks & Resources:	
1	TinyML Book (Draft Preview) – Pete Warden https://github.com/tinyMLx/tinyMLx (Open lessons and Jupyter notebooks)
2	Edge Impulse Academy https://docs.edgeimpulse.com/docs/edge-impulse-academy (Free interactive Edge AI projects with ESP32, Arduino, etc.)
3	TensorFlow Lite for Microcontrollers Guide https://www.tensorflow.org/lite/microcontrollers (Comprehensive docs for deployment on embedded platforms)
4	Arduino and Raspberry Pi Official Docs and; Projects https://www.arduino.cc/en/Tutorial/HomePage https://projects.raspberrypi.org/en/ (Hardware interfacing and AI projects)
5	TinyML on Coursera – Free to audit https://www.coursera.org/learn/tinyml-foundations

Edge AI &Embedded Intelligence (Lab)

Course Prerequisite: Programming Skills	
Lab Objectives:	
1	To introduce students to deploying AI models on edge devices like Raspberry Pi and Arduino Nano BLE.
2	To provide hands-on experience with sensor data processing, logging, and real-time inference.
3	To explore model optimization techniques such as quantization for low-power embedded deployment.
4	To guide students in integrating AI predictions with hardware actions through end-to-end edge pipelines.
Lab Outcomes: After successful completion of the course students will be able :	
1	Students will deploy and run pre-trained models on microcontrollers and embedded boards.
2	Students will capture, classify, and log real-time sensor data using Edge Impulse and ESP32.
3	Students will apply quantization and optimize models using TensorFlow Lite for edge use.
4	Students will implement a complete edge AI system that controls hardware based on inference

Suggested Experiments: Students are required to complete at least 10 experiments.	
Sr. No.	**Name of the Experiment**
1.	Deploy MobileNet to Raspberry Pi
2.	Sensor data classification via Edge Impulse
3.	Keyword spotting with Arduino Nano BLE
4.	Object recognition with Pi camera
5.	Data logging from ESP32
6.	Quantize model with TFLite
7.	Pin mapping and deployment
8.	End-to-end Edge pipeline
9.	LED actuator on inference
10.	Mini Project*

NPTEL Course

Course Code	Course Name	Teaching Scheme (Teaching Hours)			Credits Assigned			
		Theory	Practical	Tutorial	Theory	TW/ PR	Tut	Total
26ECMEA81	NPTEL COURSE	--	--	--	--	--	--	04

Course Code	Course Name	Examination Scheme					
		Theory			Term Work	Practical & Oral	Total
		Internal Assessment		End Sem Exam			
		Mid-Term Test	CA				
26ECMEA81	NPTEL COURSE	--	--	--	--	--	100

Instructions:

1. NPTEL course will be in the domain Edge Computing and Embedded Intelligence.
2. List of the courses of their respective domains will be displayed only in the beginning of the semester. (tentatively in January)
3. Students have to choose one of the courses in the mentioned domains and complete the necessary assignments and pass the exams conducted by NPTEL.
4. Marks awarded in the aforesaid exam shall be converted to corresponding credits.