

**SCHEME & SYLLABUS
OF
III AND IV SEMESTER B.E.
ELECTRONICS AND
COMMUNICATION ENGINEERING
AY: 2026-27
(Applicable to 2025-26 Batch)**

Vision

To be a center of excellence in education and research creating professionally competent and socially sensitive Electronics and Communication engineers capable of working in multicultural global environment.

Mission

- To provide quality education relevant to the current and future needs of the society ensuring experiential learning in Electronics and Communication engineers.
- To create state of the art infrastructure and research facility for learning-teaching-learning process and quality research.
- To imbibe professional ethics, human values and competency in students enabling them to work individually, and as a member or leader in multicultural global environment.

Programme Educational Objectives:

The graduates of Electronics and Communication engineering programme will

- a) Be able to design and build systems for providing solutions to real life problems in the area of Electronics and Communication.
- b) Be a successful entrepreneur, build careers in Industry, government, public sector undertakings, pursue higher education and research.
- c) Work individually, within multidisciplinary teams and lead the team following sound professional and ethical practices.

Knowledge and Attitude Profile (WK)

- WK1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.
- WK2:** Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of computer and information science to support detailed analysis and modelling applicable to the discipline.
- WK3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.
- WK4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.
- WK5:** Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar concepts, that supports engineering design and operations in a practice area.
- WK6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.
- WK7:** Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.
- WK8:** Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.
- WK9:** Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes.

Graduate attributes: Program Outcomes (POs)

- PO1: Engineering Knowledge:** Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
- PO2: Problem Analysis:** Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)
- PO3: Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
- PO4: Conduct Investigations of Complex Problems:** Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
- PO5: Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)
- PO6: The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

- PO7: Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)
- PO8: Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
- PO9: Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.
- PO10: Project Management and Finance:** Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
- PO11: Life-Long Learning:** Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8)

Program Specific Outcomes (PSOs)

A graduate of the Electronics and Communication Engineering Program will demonstrate the ability to

1. Apply Engineering knowledge to analyze, design and solve complex engineering problems in the areas related to very large scale integration (VLSI), communication, internet of things and artificial intelligence (Professional Skills).
2. Identify real world problems in the areas of electronics and communication and provide efficient solutions using modern Engineering tools/algorithm individually or working in a team with a commitment to sustainability and professional ethics (Problem solving Skills).

SCHEME OF TEACHING AND EXAMINATIONS (EFFECTIVE FROM THE ACADEMIC YEAR 2025-26)

I Semester (Chemistry Cycle) Electrical and Electronics Engineering Stream (EE, EC, EI)

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching and Learning scheme				Examination					
				Lecture	Tutorial	Practical/ Drawing	TW&SL	Total Hours / Sem.	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	Credits
1.	ASC AME1	Applied Mathematics-I (EEE Stream)	Maths	42	28	0	50	120	3	50	50	100	04
2.	ASC(IC) ACE	Applied Chemistry for Emerging Electronics and Futuristic Devices	Che	42	0	28	50	120	3	50	50	100	04
3.	ESC CAEDEE CAEDEEC	Computer-Aided Engineering Drawing for EEE Stream Computer-Aided Engineering Drawing for ECE Stream	ME	30	0	28	32	90	3	50	50	100	03
4.	ESC ESCO7 ESCO6	Introduction to Electronics and Communication Engg. Introduction to Electrical Engg.	Resp. Dept.	42	0	0	48	90	3	50	50	100	03
5.	PLC(IC) PLC5	Introduction to C Programming	CS & Allied Dept.	42	0	28	50	120	3	50	50	100	04
6.	AEC CC08	Communication Skills	Humanities (T&P)	15	0	0	15	30	2	50	50	100	01
7.	NCMC CC10	Indian Constitution and Engineering Ethics	Humanities	15	0	0	0	15	1	100	0	100	PP
8.	AEC/ SDCxx1 SDC	Innovation and Design Thinking Lab (Project-based learning- IDEA Lab Workshop/Maker's space)	Respective (Any) Dept.	0	0	28	02	30	2	50	50	100	01
		Total								450	350	800	20
9.		AICTE Activity Points (Regular students have to earn 100 activity points from I to VI semesters and Lateral Entry students have to earn 75 activity points from III to VI semesters)		Compulsory requirement for the award of a degree									
TW&SL-Team Works and Self Learning, ASC-Applied Science Course, ESC- Engineering Science Courses, IC – Integrated Course (Practical Course Integrated with Theory Course), PLC(IC)- Programming Language Course (Integrated Course), AEC- Ability Enhancement Course, AEC/SDC- Ability Enhancement Course/Skill Development course,ETC- Emerging Technology Course, TD/PSB- Teaching Department / Paper Setting Board, HSMC-Humanity, Social Science and management Course, CIE –Continuous Internal Evaluation, SEE- Semester End Examination, NCMC: Non Credit Mandatory Course, PP : (Pass/Pass) is assigned to a noncredit course. "pp" represents pass in course provided students have successfully completed the CIE requirements. Otherwise, "NP-not pass shall be awarded. "pp" is essential for the award of the degree													
Credit Definition: 1-hour Lecture (L) per week= 1Credit 2-hours Tutorial(IT) per week= 1Credit 3-2-hours Practical / Drawing (P) per week= 1Credit				04-Credits courses are to be designed for 50 hours of Teaching-Learning Session 04-Credits (IC) are to be designed for 40 hours' theory and 10-12 hours of practical sessions 03-Credits courses are to be designed for 40 hours of Teaching-Learning Session 02- Credits courses are to be designed for 25 hours of Teaching-Learning Session 01-Credit courses are to be designed for 12 hours of Teaching-Learning sessions									

ACE and PLC are integrated courses (IC), combining theory with practical components. The theory sessions shall be conducted for 3 hours per week, while the practical sessions shall be conducted for 2 hours per week. • The theory component will be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE). • The practical component will be assessed only through CIE. However, questions related to the practical content will be included in the SEE question paper as part of the final examination.	The Student Induction Programme (SIP), initiated by the All India Council for Technical Education (AICTE), is designed to help newly admitted students in technical institutions transition smoothly into the higher education environment. It aims to familiarize students with the institutional culture, foster connections with peers and faculty, and provide a foundation for holistic learning. The first year of Engineering programmes is composed of I semester and II semester and Summer Semester. SIP activities shall be scheduled in the afternoon sessions during the first week of class commencement of I and II semesters only. Activities under SIP may include Physical Activities, Creative Arts, Universal Human Values, Literary Events, Proficiency Modules, Lectures by Eminent Personalities, Local Area Visits, Department/Branch Familiarization, and Innovation-related sessions. The specific programmes to be conducted will be notified separately by the University, with the academic calendar or separately.
AICTE Activity Points Requirement for BE/B.Tech. Programmes As per AICTE guidelines (refer Chapter 6 – <i>AICTE Activity Point Program, Model Internship Guidelines</i>), in addition to academic requirements, students must earn a specified number of Activity Points to be eligible for the award of their degree. • Regular students admitted to a 4-year degree program must earn 100 Activity Points. • Lateral entry students (joining from the second year) must earn 75 Activity Points. • Students transferred from other universities directly into the fifth semester must earn 50 Activity Points from the date of entry into VTU. These Activity Points are non-credit and will not be considered for the SGPA/CGPA or be used for vertical progression. However, they are mandatory for the award of the degree, and the points earned will be reflected on the eighth semester Grade Card. The hours spent for earning the activity points shall not be counted for regular attendance requirements. Students can accumulate these points at any time during their program, including on weekends, holidays, and vacations starting from the year of admission, provided they meet the minimum hours of engagement prescribed for each activity. If a student fails to earn the required Activity Points, the eighth-semester Grade Card will be withheld until the requirement is fulfilled. Consequently, the degree will be awarded only after the Grade Card has been released.	

Code	Engineering Sciences Courses - II (ESC-II)	L	T	P	Cr		Programming Language Courses (PLC)	L	T	P	Cr
ESCO6	Introduction to Electrical Engineering	3	0	0	3	PLC5	Introduction to C Programming (for Non-IT programmes)	3	0	2	4
ESCO7	Introduction to Electronics & Communication Engg.	3	0	0	3	PLC6	Python Programming (For CSE and allied programmes)	3	0	2	4
ESCO8	Introduction to Mechanical Engineering	3	0	0	3						
ESCO9	Essentials of Information Technology	3	0	0	3						
ESCO10	Introduction to Building Sciences	3	0	0	3						
ESCO11	Applied Mechanics	3	0	0	3						

The Mathematics/Chemistry courses shall be taught by a single faculty member per session, with no sharing of the course (subject) modules. The tutorial sessions for the **mathematics** course shall be conducted in the Laboratory environment using **MATLAB software** to enhance computational understanding and application skills.

Students admitted to a specific engineering stream are required to select and successfully complete **Applied Mathematics-II** and **Applied Chemistry** courses that are aligned with their program stream. These courses are intended to reinforce the academic foundations and develop the professional competencies relevant to their chosen engineering discipline.

Engineering Sciences Courses-II (ESC-II): Courses designed to broaden the technical knowledge of students beyond their core area of study. These courses enable students to gain a foundational understanding of engineering principles from other disciplines. Students are required to select and complete the courses that do not belong to their admitted program stream. For example, a student admitted to the Civil Engineering program must choose a course such as Introduction to Mechanical Engineering or Introduction to Electrical Engineering, rather than Civil Engineering-related subjects. The course selected under Engineering Science Courses – II (ESC-II) must be different from the course chosen under ESC-I and must also not belong to the student's admitted engineering stream.

For the course **Interdisciplinary Project**, it is mandatory to form a team comprising students from multiple engineering disciplines. For example, a project team may include students from Mechanical Engineering, Electronics and Communication Engineering (ECE), and Computer Science and Engineering (CSE), working collaboratively to design and implement the project.

Computer-Aided Engineering Drawing: The courses under this category are stream-specific. Students must select and complete the course that corresponds to their admitted engineering stream.

SCHEME OF TEACHING AND EXAMINATIONS (EFFECTIVE FROM THE ACADEMIC YEAR 2025-26)

II Semester (Physics Cycle) Electrical and Electronics Engineering Stream (EE, EC, EI)

Sl. No.	Course and Course Code		Course Title	Teaching / Paper setting Dept.	Teaching and Learning scheme					Examination				Credits
					Lecture	Tutorial	Practical/ Drawing	Total Hours / Sem.	Duration in hrs.	CIE Marks	SEE Marks	Total Marks		
1.	ASC	AME2	Applied Mathematics-II (EEE Stream)	Maths	42	28	0	50	120	03	50	50	100	04
2.	ASC(IC)	APEE APEC	EE Electrical Engineering Materials EC, EI Quantum Physics and Electronics Sensors	Phy	42	0	28	50	120	03	50	50	100	04
3.	PSC	PSC3 PSC4	EE Basics of Electrical Engineering EC, EI Fundamentals of ECE	Resp. Dept.	42	0	0	48	90	03	50	50	100	03
4.	ESC	ESCO9	Essentials of Information Technology	Resp. Dept.	42	0	0	48	90	03	50	50	100	03
5.	ETC	ETC13	Introduction to AI and Applications	CS & Allied Dept.	42	0	0	48	90	03	50	50	100	03
6.	AEC	CC09	Soft Skills	Humanities (T&P)	15	0	0	0	15	01	100	---	100	PP
7.	PSCL	PSCL3 PSCL4	EE Basic Electrical Laboratory EC, EI Fundamentals of ECE Lab	Resp. Dept.	0	0	28	02	30	02	50	50	100	01
8.	HSMS	CC04/ CC03	Samkrutika Kannada / Balake Kannada	Humanities	15	0	0	15	30	01	50	50	100	01
9.	AEC/ SDC	SDC2	Interdisciplinary Project-Based Learning	Resp. Dept. (Multiple Dept.)	0	0	0	30	30	02	50	50	100	01
			Total								500	400	900	20
10.			AICTE Activity Points (Regular students have to earn 100 activity points from I to VI semesters and Lateral Entry students have to earn 75 activity points from III to VI semesters)								Compulsory requirement for the award of a degree			

TW&SL-Team Works and Self Learning, ASC-Applied Science Course, ESC-Engineering Science Course, IC – Integrated Course (Practical Course Integrated with Theory Course), PLC(IC)- Programming Language Course (Integrated Course), AEC- Ability Enhancement Course, AEC/SDC- Ability Enhancement Course/Skill Development course, ETC- Emerging Technology Course, TD/PSB- Teaching Department / Paper Setting Board, HSMC-Humanity, Social Science and management Course, CIE –Continuous Internal Evaluation, SEE- Semester End Examination, NCMC: Non Credit Mandatory Course, PP : (Pass/Pass) is assigned to a non-credit course. "pp" represents pass in course provided students have successfully completed the CIE requirements. Otherwise, "NP-not pass shall be awarded. "pp" is essential for the award of the degree

APE is an integrated course (IC), combining theory with practical components.

The theory sessions conducted for 3 hours per week, while the practical sessions will be conducted for 2 hours per week.

- The theory component will be evaluated through both Continuous Internal Evaluation (CIE) and Semester End Examination (SEE).
- The practical component will be assessed only through CIE. However, questions related to the practical content will be included in the SEE question paper as part of the final examination.

Code	Program Specific Course (PSC)	L	T	P	Cr	Code	Program Specific Course Lab (PSCL)	L	T	P	Cr
PSC1	Building Materials and Concrete Technology	3	0	0	3	PSCL1	Building Materials Lab	0	0	2	1
PSC2	Elements of Mechanical Engineering	3	0	0	3	PSCL2	Elements of Mechanical Engineering Lab	0	0	2	1
PSC3	Basics of Electrical Engineering	3	0	0	3	PSCL3	Basic Electrical Laboratory	0	0	2	1
PSC4	Fundamentals of ECE	3	0	0	3	PSCL4	Fundamentals of Electronics & Communication Engg. Lab	0	0	2	1
PSC5	Structured Programming in C	3	0	0	3	PSCL5	C Programming Lab	0	0	2	1
PSC6	Elements of Biotechnology and Biomimetics	3	0	0	3	PSCL6	Elements of Biotechnology Laboratory	0	0	2	1
PSC7	Principles of Soil Science and Agronomy	3	0	0	3	PSCL7	Soil Science and Agronomy Field Lab	0	0	2	1
PSC8	Building Materials	3	0	0	3						
	Engineering Science Courses (ESC)										
ESCO6	Introduction to Electrical Engineering	3	0	0	3						
ESCO7	Introduction to Electronics & Communication Engineering	3	0	0	3						
ESCO8	Introduction to Mechanical Engineering	3	0	0	3						
ESCO9	Essentials of Information Technology	3	0	0	3						
ESCO10	Introduction to Building Sciences	3	0	0	3						

The Mathematics/Physics courses shall be taught by a single faculty member per session, with no sharing of the course (subject) modules. The tutorial sessions for the mathematics course shall be conducted in the Laboratory environment using MATLAB software to enhance computational understanding and application skills.

Students admitted to a specific engineering stream are required to select and successfully complete **Applied Mathematics-I** and **Applied Physics** courses that are aligned with their program stream. These courses are intended to reinforce the academic foundations and develop the professional competencies relevant to their chosen engineering discipline.

Programme Specific Courses (PSC): Programme Specific Courses (PSC) are a set of core courses tailored to the specific branch or discipline of engineering in which a student is enrolled (e.g., Mechanical Engineering, Computer Science, Civil Engineering, etc.). These courses are intended to provide students with in-depth knowledge and specialized skills essential for professional competence in their chosen field. Students must select and complete the courses from this group that **correspond to their admitted program stream**. Similarly, students are also required to choose and pass laboratory courses that are specific to their stream from the **Programme Specific Courses Laboratory (PSCL)** group.

Engineering Sciences Courses-I (ESC-I): Courses designed to broaden the technical knowledge of students beyond their core area of study. These courses enable students to gain a foundational understanding of engineering principles from other disciplines. Students are required to select and complete the courses that do not belong to their admitted program stream. For example, a student admitted to the Civil Engineering program must choose a course such as Introduction to Mechanical Engineering or Introduction to Electrical Engineering, rather than Civil Engineering-related subjects. The course selected under Engineering Science Courses – II (ESC-II) must be different from the course chosen under ESC-I and must also not belong to the student's admitted engineering stream.



SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

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B.E. in Electronics and Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (2025 Scheme) (w.e.f. 2026-27)

III Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching and Learning scheme					Examination				Credits		
				Lecture	Tutorial	Practical/ Drawing	TW&SL	Total Hours / Sem.	Duration in hrs.	CIE Marks	SEE Marks	Total Marks			
														L	T
1.	P3EC1	Mathematics for Signal Processing	Maths / Specific department	42	28	0	50	120	3	50	50	100	4		
2.	P3EC11	Digital Electronic Circuits with Verilog	Resp. Dept.	42	0	28	50	120	3	50	50	100	4		
3.	P3EC2	Linear System Analysis	Resp. Dept.	42	28	0	50	120	3	50	50	100	4		
4.	P3EC3	Computer Organization & Architecture	Resp. Dept.	42	0	0	48	90	3	50	50	100	3		
5.	P3EC4	Analog Electronic Circuits	Resp. Dept.	42	0	0	48	90	3	50	50	100	3		
6.	P3ECL1	Analog Electronic Circuits Lab	Resp. Dept.	0	0	28	2	30	2	50	50	100	1		
7.	P3ECA1	Ability Enhancement Course Laboratory	Resp. Dept.	0	0	28	2	30	2	50	50	100	1		
8.	SDCEC3	Community Project (Project-Based Learning)	Any Dept. / Resp. Dept.	0	0	0	30	30	2	50	50	100	1		
9.	NCMC	National Service Scheme (NSS)	NSS coordinator	0	0	0	28	28	--	100	--	100	PP		
		Physical Education (PE) (Sports and Athletics)	Ph.Edn. Director												
		Yoga (Yoga Teacher)													
		Music (Music Teacher)													
10.		SKILL Lab-I				25-30							1		
		Total										600	400	1000	22
	AAP	AICTE Activity Points (Regular students have to earn 100 activity points from I to VI semesters and Lateral Entry students have to earn 75 activity points from III to VI semesters)													
10.	P3MAT DIP	Foundations of Engineering Mathematics-I	Maths Dept.	14	0	0	14	28	3	100	---	100	PP		
Compulsory requirement for the award of a degree															
Note: ASC: Applied Science Course, IPCC: Integrated Professional Core Course, PCCCL: Professional Core Course laboratory, AEC: Ability Enhancement Course, SDC: Skill Development Course, NCMC: Non Credit Mandatory Course L: Lecture, T: Tutorial, P: Practical, SL: Self Learning, TW&SL: Team works & Self Learning CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation.															
Ability Enhancement Course (Laboratory)															
P3ECA1	Internet of Things		P3ECA3	Signal Processing with R											
P3ECA2	Matlab for EC Engineering		P3ECA4	Electric Circuit Analysis											
Ability Enhancement Course Laboratory can be offered either as a single compulsory course or as multiple elective options.															



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B.E. in Electronics and Communication Engineering

SCHEME OF TEACHING AND EXAMINATION (2025 Scheme) (w.e.f. 2026-27)

IV Semester

Sl. No.	Course and Course Code	Course Title	Teaching / Paper setting Dept.	Teaching and Learning scheme					Examination				Credits
				Lecture	Tutorial	Practical/ Drawing	TW&SL	Total Hours / Sem.	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1.	P4EC1	Mathematics for Communication	Maths/ Specific department	42	0	0	48	90	3	50	50	100	3
2.	P4EC11	ARM Microcontroller	Resp. Dept.	42	0	28	50	120	3	50	50	100	4
3.	P4EC2	Engineering Electromagnetics and Microwave Engineering	Resp. Dept.	42	28	0	50	120	3	50	50	100	4
4.	P4EC4	Communication Systems I	Resp. Dept.	42	0	0	48	90	3	50	50	100	3
5.	P4ECL1	Communication Systems I Lab	Resp. Dept.	0	0	28	2	30	2	50	50	100	1
6.	P4ECA1	Ability Enhancement Course Laboratory	Resp. Dept.	0	0	28	2	30	2	50	50	100	1
7.	P4ECB1	Biomedical Signals and Applications	Resp. Dept.	15	0	0	15	30	2	50	50	100	1
8.	P4EC3	AI Applications in Electronics and Communication Engineering	Resp. Dept.	15	0	0	15	30	2	50	50	100	1
9.	SDCEC4	Environmental Science Project	JBoS	0	0	0	30	30	2	50	50	100	1
10.	NCMC	PMC1 National Service Scheme (NSS)	NSS coordinator	0	0	0	28	28	--	100	--	100	PP
		PMC2 Physical Education (PE) (Sports and Athletics)	Ph.Edn. Director										
		PMC3 Yoga (Yoga Teacher)											
		PMC4 Music (Music Teacher)											
11.		Skill Lab-II											1
		Total								550	450	1000	20
		AICTE Activity Points (Regular students have to earn 100 activity points from I to VI semesters and Lateral Entry students have to earn 75 activity points from III to VI semesters)											
11.	P4MAT DIP	Foundations of Engineering Mathematics-II	Maths Dept.	14	0	0	14	28	3	100	---	100	PP
Note: ASC: Applied Science Course PCC : Professional Core Course, IPCC : Integrated Professional Core Course, PCCL : Professional Core Course laboratory, AEC : Ability Enhancement Course, SDC : Skill Development Course NCCMC : Non Credit Mandatory Course L : Lecture, T : Tutorial, P : Practical SL : Self Learning TW&SL : Team works & Self Learning CIE : Continuous Internal Evaluation, SEE : Semester End Evaluation.													
Ability Enhancement Course (Laboratory)													
P4ECA1	Advanced Technical Training-C++ Lab	P4ECA3	Advanced Digital Design using System Verilog										
P4ECA2	Communication Applications using Python	P4ECA4	Industrial IoT										

Environmental Science Project: The Environmental Science Project is an applied learning component designed to develop students' awareness, understanding, and responsibility toward the environment. It provides an opportunity to study real-world environmental issues and apply scientific and engineering principles to design feasible and sustainable solutions.

The topics under environment include, but not limited to, climate change, biodiversity, air and water pollution, land use, excess use of natural resources, earthquakes, rise in the earth's temperature, power generation, soil erosion, environment issues related program, etc.

The project involves problem identification, field surveys, case studies, data collection, environmental audits, analysis, and proposal of remedial or preventive measures aimed at improving biodiversity, air quality, and thermal comfort, etc. Students can take up project individually or in a group not exceeding 4 students. Students can opt for Interdisciplinary Project based on their interest.

The evaluation shall be done as per the following;

CIE: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide. The CIE marks awarded for the project work, shall be based on the rubrics.

SEE: SEE will be conducted by the two examiners appointed by the Institute. The SEE marks awarded for the project work shall be based on the rubrics.

MATHEMATICS FOR SIGNAL PROCESSING

Contact Hours/ Week:	: 3+2+0	Credits:	4
Total Lecture Hours:	: 42	CIE Marks:	50
Total Tutorial Hours	: 28	SEE Marks:	50
Sub. Code:	: P3EC1		

Course objectives:

This course will enable students to:

1.	Study the characteristics, representation and properties of signals and systems in time as well as frequency domains.
2.	Evaluate the behaviour of an LTI system.
3.	Apply transformations on signals.

UNIT I

Introduction to Signals: Definition of signals and systems, Mathematical Representation, Classification of signals, Operations on signals, Elementary signals, Signals and Vectors: component of a vector, Component of a signal Orthogonality in complex signals, Energy of the sum of orthogonal signals.

9 Hours

UNIT II

Time Domain Representation of LTI Systems: Introduction, Properties of systems, impulse response representation of LTI systems, Response of the LTI systems: linear convolution using graphical method, Properties of impulse response representation.

9 Hours

UNIT III	
Fourier representations for signals: Introduction, Discrete Time non periodic signals: DTFT & IDTFT representations, Continuous Time non periodic signals: FT & IFT representation, Properties of DTFT & FT.	
8 Hours	
UNIT IV	
Applications of Fourier representations: Introduction, Frequency response of LTI systems, Application of DTFT to compute impulse response. Fourier Transform representation of periodic signals.	
8 Hours	
UNIT V	
Z-Transform: Introduction, Properties of ROC, Properties of Z-transform, inversion of Z-transform by Partial fraction expansion method, Transform analysis of LTI systems, stability & causality.	
8 Hours	

TEXT BOOKS		
1	Simon Haykin, Barry Van Ven	Signals and systems, John Wiley, 2 nd Edition, Indian Edition, 2008.
2	J. G. Proakis & D. G. Manolakis	Digital Signal Processing: Principles, Algorithms and Applications, PHI, 4 th Edition, 2014.
REFERENCE BOOKS		
1	Sanjit K. Mitra	Digital Signal Processing: A Computer-Based Approach. TMH. 4 th Edition, 2013.
2	H.P. HSU	Schaum's Outlines- Signals & Systems, TMH, 2 nd Edition, 2010.
3	Alan V. Oppenheim, Alan S. Willsky, Syed Hamid Nawab	Signals & Systems, PHI, 2 nd Edition, 2014.
4	B P Lathi	Principles of Signal Processing and Linear systems, Oxford University Press, 8 th Edition, 2014.

E-RESOURCES

1	https://nptel.ac.in/courses/117101055
2	https://www.digimat.in/nptel/courses/video/108104100/L02.html
3	https://nptel.ac.in/courses/117104074
4	https://archive.nptel.ac.in/courses/108/106/108106163
5	https://www.youtube.com/watch?v=wMflxR3KsXg

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Apply knowledge of Mathematics and Engineering fundamentals to Identify and characterize different classes of signals.
CO2	Identify, formulate the methodology to compute the response and analyze the properties of an LTI system.
CO3	Identify Fourier Representations and analyze the signals in time and frequency domain.
CO4	Apply Fourier representations to compute the characteristics of LTI systems in both time and frequency domain.
CO5	Apply ZT for broader characterization of discrete time signals and LTI systems.

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2							2	
	CO2	3	2			2							2	
	CO3	3	2			2							2	
	CO4	3	2			2							2	
	CO5	3	2			2							2	

DIGITAL ELECTRONIC CIRCUITS WITH VERILOG

Contact Hours/ Week:	3+0+2	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	28	SEE Marks:	50
Sub Code:	P3ECI1		

Course objectives:

This course will enable students to :

1. Simplify Boolean expressions using K Maps.
2. Analyze and design combinational and sequential logic circuits
3. Develop Verilog codes for combinational and sequential logic circuits
4. Analyze and design combinational circuits using PLDs.

UNIT I

Properties of logic gates: Noise Margin, Fan-out, Propagation Delay, Power Dissipation.

Simplification of Boolean Expressions: Canonical forms, Karnaugh maps (3 and 4 variable)

Introduction to Verilog HDL: HDL basic concepts, Syntax & semantics, Data types, Operators, HDL modeling types, Developing HDL code for logic circuits using Verilog HDL program.

9 Hours

UNIT II

Combinational Logic Circuits: Binary adders and subtractors, Carry look-ahead adder, Decimal adders, Comparators- one bit and two bit, Decoders, Encoder, Multiplexer, Demultiplexer, Logic design using decoders and multiplexers. Modeling combinational logic circuits using dataflow, gate level and behavioral Verilog HDL program.

8 Hours

UNIT III	
Sequential Circuit design: Basic bi-stable element, Latches- SR Latch using NAND gates, D Latch, Gated D Latch, Flip-flops – SR, D, JK and T, Characteristic equations, Flip flop conversions. Registers: shift register- SISO, SIPO, PISO, Universal shift register. Counters: asynchronous and MOD counter, ring Counter and Johnson counter, Modeling sequential circuits using behavioral Verilog HDL program.	
9 Hours	
UNIT IV	
Synchronous counter design, Introduction to Mealy and Moore models. Finite state machine (Mealy model): state graph and synchronous sequential circuit design, design of Sequence detector (non-overlapping), synchronous sequential circuit analysis.	
8 Hours	
UNIT V	
Programmable logic Devices(PLDs): PROMs, Programmable logic arrays (PLAs), Programmable array logic (PALs): structure, logic diagram, representation in PLD notation, Logic design using PLDs, Introduction to FPGA. Static and Dynamic Hazards in combinational networks: Static hazards: detecting static hazards, eliminating static hazards, Dynamic Hazards	
8 Hours	

TEXT BOOKS		
1	Donald D. Givone	Digital Principles and Design, TATA Mc Graw-hill, 2017.
2	Samir Palnitkar	Verilog HDL A guide to Digital Design and Synthesis, Pearson Education, 2 nd Edition, 2003.

REFERENCE BOOKS		
1	Ronald J Tocci, Neal S Widmer and Regory L Moss.	Digital Systems Principles and Applications, Pearson, 12 th Edition, 2017.
2	Charles H. Roth. Jr.	Digital Systems Design using Verilog, Thomson Learning, Inc, 1 st Edition, 2015.
3	M Morris Mano & Michael D.Ciletti	Digital Design with an introduction to the Verilog HDL, Pearson Education, 5 th Edition, 2013.

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Apply the knowledge of K-Maps for simplification of Boolean expressions and develop Verilog code for logic circuits.
CO2	Design combinational circuits and build Verilog code for the same
CO3	Implement shift registers and counters by selecting Flip Flops and develop Verilog code.
CO4	Design Finite state machine using Mealy model
CO5	Design logic circuits using programmable logic devices and Analyze different Hazards in combinational networks

Course Articulation Matrix

	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	1			1			2	1		2	2	1
	CO2	3	2			1			2	1		2	2	1
	CO3	3	2			1			2	1		2	2	1
	CO4	3	2			1			2	1		2	2	1
	CO5	3	2			1			2	1		2	2	1

Integrated Lab:**List of Experiments:****Part-A Hardware Experiments:**

1.	Realization of Parallel Adder/ Subtractor.
2.	Multiplexer: Adder and Subtractor using MUX.
3.	Use of Decoder chip to drive LED display.
4.	Realization of One bit magnitude comparator.
5.	Design and implementation of mod counters

Part-B Digital Circuit Design using Verilog and FPGA Implementation

1.	Full adder using (i) Dataflow description (ii) Gate-level description
2.	Multiplexer using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
3.	Decoder using (i) Dataflow description (ii) Gate-level description (iii) Behavioral description
4.	D, JK, T Flip Flop using behavioral description.
5.	Develop Verilog code for up/down counter

LINEAR SYSTEM ANALYSIS

Contact Hours/ Week:	3+2+0	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Tutorial Hours:	28	SEE Marks:	50
Sub. Code:	P3EC2		

Course objectives:

This course will enable students to:

1.	Analyze transient and steady state parameters of electrical circuits using basic laws, theorems and Laplace transformation
2.	Develop mathematical modeling of control systems, and determine its transfer function.
3.	Analyze stability of a given system in time and frequency domain.
4.	Analyze LTI systems using state space model.

UNIT I

Basic Laws and Methods of Analysis: Kirchoff's laws, Wye-Delta, Nodal Analysis & Mesh Analysis.

Circuits Theorems: Superposition, Thevenin's, Norton's and Maximum power transfer theorems.

9 Hours

UNIT II

Transient Analysis: Initial and final values and their derivatives, Transient analysis of RL & RC circuits.

Applications of Laplace Transforms in circuit analysis: Initial and final Value Theorem, Laplace transform of periodic functions, Waveform synthesis, Solution of network using Laplace Transform.

9 Hours

UNIT-III

Modeling of linear-time-invariant Systems: Introduction to control system, Open loop and Closed loop systems, Mathematical models of Electronic systems and transfer function, Block diagram representation, Signal Flow graph, Mason's gain formula applicable to Electrical and Electronics systems.

8 Hours

UNIT IV

Time Response Analysis: Unit step response of second order linear-time-invariant systems (Qualitative), time domain specifications, transient response of second order linear-time-invariant systems, steady state error analysis.

Concept of Stability: Routh-Hurwitz Criteria, Relative Stability analysis.

Root-Locus Techniques: The root locus concepts, Construction of Root-loci, Effect of addition of poles and zeros to the linear time invariant systems.

8 Hours**UNIT V**

Frequency-response analysis: Bode plots, Closed-loop frequency response (Transfer function) from Bode Plot, and Stability analysis of systems.

Introduction to State variable analysis: Concepts of state, state space, state variable, state model of electrical systems, State equation, State transition matrix and its properties, Solution of state equation of LTI System.

8 Hours**TEXT BOOKS**

1	Charles K Alexander and Matthew N O Sadiku	Fundamental of Electric Circuits, McGraw-Hill, 5 th Edition, 2013.
2	Richard C. Dorf and Robert H. Bishop	Modern Control Systems, Pearson Education, 13 th Edition, ISBN-13:978-0134407623.2013,
3	Nagrath and Gopal M.	Control Systems Engineering. New Age International (P) Limited, 4 th Edition, 2005. ISBN 13: 9788122422849.

REFERENCE BOOKS

1	Hayt Kemmerly and Durbin	Engineering circuit analysis, TMH, 8 th Edition, 2013.
2	Ogata K.	Modern Control Engineering. Pearson Education Asia/PHI, 5 th Edition, 2021.
3	Kuo C. Benjamin	Automatic Control Systems, Wiley; 9 th Edition, 2014 Language: English, ISBN-13: 978-8126552337.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyze a given electrical circuit using basic laws and theorems.
CO2	Analyze Transient and steady state behavior of RL, RC, and RLC circuits in time and transform domain.
CO3	Formulate the mathematical model for linear-time-invariant systems and obtain the transfer functions.
CO4	Analyze transient responses and stability of linear-time-invariant systems in time domain.
CO5	Analyze the stability of LTI system using Bode Plot Technique and obtain solution using state space analysis.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	1	-	-	2	-	-	1	1	-	1	2	1
	CO2	3	1	-	-	2	-	-	1	1	-	1	2	1
	CO3	3	1	-	-	2	-	-	1	1	-	1	2	1
	CO4	3	1	-	-	2	-	-	1	1	-	1	2	1
	CO5	3	1	-	-	2	-	-	1	1	-	1	2	1

COMPUTER ORGANIZATION AND ARCHITECTURE

Contact Hours/Week	: 3+0+0	Credits	: 3
Total Lecture Hours	: 42	CIE Marks	: 50
Sub. Code	: P3EC3	SEE Marks	: 50

Course Objectives: This course will enable students to:

1. Articulate the operational concepts and programming techniques of general purpose computer.
2. Appraise the Input output organization and memory system.
3. Illustrate the operations of different blocks of computer system.

UNIT I

Basic Structure of Computers and Machine Instructions

Basic Operational Concepts, Performance – Processor Clock, Basic Performance Equation, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, Addressing Modes, Assembly Language Stacks, Subroutines, Additional Instructions.

9 Hours

UNIT II

Computer Arithmetic:

Addition and Subtraction of Signed Numbers: ripple adder, carry look ahead adder, Design of Fast Adders, Multiplication of Positive Numbers: Array Multiplier sequential multiplier, Multiplication of Signed Numbers: Booth algorithm, Integer Division: Restoring and Non restoring algorithms

8 Hours

UNIT III	
Processing Unit: Fundamental Concepts, Execution of a Complete Instruction: Load Instructions, Arithmetic and Logic Instructions, Store Instructions Hardware Components: Register File, ALU, Data path, Instruction Fetch and Execution Steps.	
8 Hours	
UNIT IV	
Parallel Processing: SISD, SIMD, MISD, MIMD, Pipelining: general considerations, speed up, Arithmetic pipeline, Instruction pipeline – Data dependency, Handling branch instructions, RISC pipeline, Vector Processing – Vector operations, Superscalar processors, Supercomputers.	
8 Hours	
UNIT V	
Input /Output Organization: Accessing I/O Devices: Accessing IO devices, IO device interface, program controlled IO, Interrupts. Memory System: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, DMA, Memory Hierarchy, Cache Memories – Mapping Functions, Replacement techniques, cache write policies.	
9 Hours	

Text Books:

1	Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian	Computer Organization and Embedded systems, Tata McGraw Hill, 6 th Edition, 2012.
2	M. Morris Mano	Computer System Architecture, PHI, 3 rd Edition.

Reference Books

1	William Stallings:	Computer Organization & Architecture, Pearson, 9 th Edition, 2015.
2	David A. Patterson and John L. Hennessy	Computer Organization and Design: The Hardware/Software interface, Elsevier, 3 rd Edition, 2005.

E-Resources :

1	https://archive.nptel.ac.in/courses/106/105/106105163/
2	https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation-architecture
3	https://drive.google.com/file/d/1jgy5Kb_jrPDCbVUCX7DDRWthQYRpI8lE/view

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Demonstrate machine instructions, addressing techniques, and instruction sequencing in a computer system.
CO2	Analyse the implementations of algorithms to compute arithmetic operations.
CO3	Illustrate the functionalities of processor architecture.
CO4	Analyze the pipelining and parallel processing techniques used to enhance the computational capability of a computer system.
CO5	Illustrate the functionalities of different memory organizations.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	1	3										2	
	CO2	2	2										2	
	CO3	2	1										1	
	CO4	2	3										3	
	CO5	2	3										3	

ANALOG ELECTRONIC CIRCUITS

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	: P3EC4	SEE Marks:	50

Course objectives:

1.	Introduction of MOSFET device and design of fundamental MOSFET analog circuits.
2.	Design and analysis of Differential amplifiers and concepts of Power amplifiers.
3.	Discuss the concept of Opamp as a black-box and design of basic Opamp based circuits.
4.	Introduction to Linear ICs and design of 555 timer, Data converters and PLL based circuits.

UNIT I

Device structure, Operation, i_D - V_{DS} characteristics, MOSFET Circuit at DC. MOSFET operation as a switch and as a Linear Amplifier (qualitative analysis). MOSFET biasing by fixing V_{GS} , Biasing by fixing V_G and connecting a resistance in the source, Biasing Using a Drain to Gate feedback Resistor, Constant-Current-Source Biasing (using current mirror).

9 Hours

UNIT II

DC Bias Point, Signal Current in the Drain Terminal, Voltage Gain, Small-Signal equivalent-circuit models, Trans conductance g_m , The T-equivalent Circuit model. Common Source Amplifier, Common Source Amplifier with Source Resistance, Common Gate Amplifier (qualitative analysis), Common Drain Amplifier (qualitative analysis), Comparison. High-Frequency Model, Frequency Response of CS Amplifier (qualitative analysis), Cascode amplifiers.

9 Hours

UNIT III	
The MOS differential pair and their small signal operation, Differential amplifiers with active load. Power amplifiers: Classification, Class A, B, AB and class C power amplifiers.	
8 Hours	
UNIT IV	
Review of Op-Amp, Various applications of Op-Amp like Comparator, Zero-crossing detector, Instrumentation amplifier, Square wave generator, Schmitt trigger, Precision rectifier, peak detector, sample and hold circuit. Filters: First and second order low-pass and high-pass Butterworth filter, Band-pass filters, Band reject filters, All pass filters (qualitative analysis).	
8 Hours	

UNIT V	
Linear ICs: 555 timer IC and its application, Astable, Mono stable MV. PLL, DAC: basics, binary weighted R-DAC and R-2R DAC, ADC: DAC based ADC, Successive approximation ADC, Flash ADC	
8 Hours	

TEXT BOOKS			
1	Adel S. Sedra, Kenneth Carless Smith	Microelectronic Circuits Theory and Applications, Oxford University Press, 2022 (reprint).	7 th Edition.
2	Behzad Razavi	Fundamentals of Microelectronics, Wiley, Edition, 2021.	3 rd
3	Sergio Franco	Design with Operational amplifiers and Analog Integrated circuits, Mc Graw Hill, 4 th Edition, 2026 (reprint).	

REFERENCE BOOKS			
1	Robert L. Boylestad and Louis Nashelsky.	Electronic Devices and Circuit Theory. Edition, PHI, 2024.	11 th
2	Robert F. Coughlin and Frederick F, Driscoll.	Operational Amplifiers and Linear integrated Circuits, PHI, 6 th Edition, 2016 (reprint).	

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyse the MOSFET structure, working and design of biasing circuit.
CO2	Design the CS, CG, CD and Differential amplifiers and compare the performance
CO3	Analyze Power amplifiers and design Class A, Class B power amplifiers.
CO4	Design Opamp based applications such as comparator, Instrumentation amplifier, Schmitt trigger, waveform generators, rectifiers and filters.
CO5	Design circuits using Timer, PLL, ADC and DAC ICs and Op-Amps

Course Articulation Matrix

	POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	1	2
CO1	3				2		1	1	1		1	3	1
CO2	3				2		1	1	1		1	3	1
CO3	3											3	
CO4	3				2		1	1	1		1	3	1
CO5	3											3	

ANALOG ELECTRONIC CIRCUITS LAB

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P3ECL1	SEE Marks:	50

Rig Up Experiments:

1. Regulated DC power supply
2. Class-B push pull power amplifier
3. Digital to Analog Converters
4. Analog to Digital Converters
5. Instrumentation amplifier

Rig Up Experiments using Analog Discovery 2 – NI Edition Kit

6. Precision Rectifier using op-amp
7. Schmitt trigger using op-amp.
8. Astable multivibrator using 555 timer
9. Monostable multivibrator using 555 timer
10. II Order Butterworth LPF and HPF
11. MOSFET amplifier (common source)

Study Experiments:

1. Simulation of two level clipping circuit using zener diodes.
2. Simulation of Transfer and Drain Characteristics of MOSFET in Common Source Configuration.
3. Simulation of MOSFET / Transistor as switch.
4. Simulation of MOS capacitor

ABILITY ENHANCEMENT COURSE LABORATORY

INTERNET OF THINGS LAB

Contact Hours/ Week:	0+0+2	Credits:	01
Total Lecture Hours:	28	CIE Marks:	50
Course Code:	P3ECA1	SEE Marks:	50

Course objectives:

This course will enable students to:

- | | |
|----|--|
| 1. | Discuss the fundamentals of Internet of Things and its building blocks along with their characteristics. |
| 2. | Understand IoT systems using sensors, single board computers and actuators. |

List of experiments (using Arduino / Virtual Lab)

- | | |
|-----|---|
| 1. | Develop a program to blink the LED |
| 2. | Develop a program to connect the push button, buzzer and LED. |
| 3. | Develop a program to display message on LCD. |
| 4. | Develop a program to interface ultrasonic sensor. |
| 5. | Develop a program to interface IR sensor. |
| 6. | Develop a program to interface DC motor / stepper motor / servo motor |
| 7. | Develop a program to upload LDR data to Thingspeak cloud. |
| 8. | Develop a program to upload temperature and humidity data to Thingspeak cloud. |
| 9. | To simulate the interfacing of soil moisture sensor with Arduino using Virtual Lab. |
| 10. | To simulate the interfacing of MQ135 sensor with Arduino using Virtual Lab. |

Course Outcomes:

Upon completion of this course the student will be able to:

- | | |
|-----|--|
| CO1 | Develop an IoT Systems using sensors, processors and actuators. |
| CO2 | Integrate sensors with Arduino controller to IoT and access the cloud. |

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2				1			2	1
	CO2	3	2			2				1			2	1

MATLAB FOR EC ENGINEERING

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P3ECA2	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Impart practical working knowledge of Electrical and Electronics Simulation and Analysis using Mathematical computing languages such as MATLAB.
2.	Solve, Simulate and Analyze basic Electrical and Electronics Circuits and Applications by writing Ohm's law, KCL and KVL Mathematical Equations and Programs.
3.	Develop hands-on working experience with reference to Solve, Simulate and Analyze Electrical & Electronics Circuits using MATLAB.

List of Experiments

1. Gain versus Frequency of an RC Amplifier
2. A 3-bit A/D Converter
3. Nodal Voltage Circuit with Dependent Sources
4. Power Calculations of One-port Network
5. Magnitude and Phase Response of an RLC circuit
6. h-parameters of Bipolar Junction Transistor
7. Amplitude and Phase Spectrum of Full-wave Rectifier Waveform
8. Power Spectral Density of a Noisy Signal
9. Full-wave Rectifier – Ripple Voltage, DC Output Voltage, Discharge Time and Period of Ripple
10. Frequency Response of a Common Emitter Amplifier

TEXT BOOKS:

1	Rudra Pratap	Getting started with MATLAB, Oxford University Press, 2019.
2	S. K. Bhattacharya	Basic Electrical and Electronics Engineering, Pearson Education India, 2012 Edition.

REFERENCE BOOKS:

1	Rajkumar Bansal	MATLAB and its Applications in Engineering, Pearson Publishers, ISBN-10: 8131716813, 2009.
2	Dr. N. K. Jain	A Text Book of Practicals in Electrical Engineering, Dhanpat Rai Publishing Company, 2009.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyze the main features and importance of the MATLAB mathematical programming environment.
CO2	Apply working knowledge of MATLAB to simulate and solve Electrical, Electronic circuits and Applications.
CO3	Solve, simulate and analyze various DC circuits.
CO4	Solve, simulate and analyze various AC circuits.
CO5	Solve, simulate and analyze various Analog Electronics circuits.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2			2	2			2	2
	CO2	3	2			2			2	2			2	2
	CO3	3	2			2			2	2			2	2
	CO4	3	2			2			2	2			2	2
	CO5	3	2			2			2	2			2	2

SIGNAL PROCESSING WITH R

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P3ECA3	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Simulate discrete time signals and verification of sampling theorem.
2.	Compute the DFT for a discrete signal and verification of its properties using R.
3.	Find solution to the difference equations and computation of convolution and correlation along with the verification of properties.
4.	Compute and display the filtering operations and compare with the theoretical values.

List of Experiments

1. Verification of sampling theorem (use interpolation function).
2. Determine the Impulse response of first order and second order system.
3. Linear and circular convolution of two given sequences, Commutative, distributive and associative property of convolution.
4. Overlap Save Block Convolution and Overlap Add Block Convolution
5. Auto and cross correlation of two sequences and verification of their properties.
6. Solving a given difference equation.
7. Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).
8. Verification of DFT properties (like Linearity and Parseval's theorem, etc.)
9. Design and implementation of Low pass and High pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering.

10. Design and implementation of a digital IIR filter (Low pass and High pass) to meet given specifications and test with an audio file. Plot the spectrum of audio signal before and after filtering.

TEXT BOOK:

1	Tilman M. Davies	The Book of R, A First Course in Programming and Statistics, No Starch Press, 2016.
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REFERENCE BOOKS:

1	Garrett Grolmund	Hands-On Programming with R, O'Reilly Media, 2014.
2	John G. Proakis, Dimitris G. Manolakis	Digital Signal Processing, Pearson, 4 th edition, 2007.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyze the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
CO2	Model the discrete time signals and systems and verify its properties and results.
CO3	Implement signal processing algorithms using R.
CO4	Realize the digital filters using a simulation tool and analyze the response of the filter for an audio signal.
CO5	Write programs using R to illustrate DSP concepts.

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2			1	1		1	2	2
	CO2	3	2			2			1	1		1	2	2
	CO3	3	2			2			1	1		1	2	2
	CO4	3	2			2			1	1		1	2	2
	CO5	3	2			2			1	1		1	2	2

ELECTRIC CIRCUIT ANALYSIS

Contact Hours/ Week:	: 0+0+2	Credits:	1
Total Practical Hours:	: 28	CIE Marks:	50
Sub. Code:	: P3ECA4	SEE Marks:	50

Course objectives:

This course will enable students to:

1. Learn the usage of modern tools to analyze given electrical and electronic circuits.
2. Design an electronic system and implementation using hardware.

List of experiments (LT-Spice/Virtual Lab)

1. Star-Delta transformation.
2. Source shifting and transformation.
3. Loop analysis of electrical circuit with independent sources.
4. Nodal analysis of electrical circuit with independent sources.
5. Circuit analysis with dependent sources.
6. Verification of Thevenin's & Norton's theorem.
7. Verification of Superposition theorem.
8. Verification of Maximum power transfer theorem.
9. Resonance.
10. Transient Analysis of RL and RC circuits.

E-RESOURCES

- 1 <https://www.youtube.com/watch?v=JRcyHuyb1V0>
- 2 <https://da-iitb.vlabs.ac.in/List%20of%20experiments.html>
- 3 <https://nptel.ac.in/courses/106105165>

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Apply Circuit laws and analyse an electrical system using LT-Spice.
CO2	Analyse and design an electronic system and implement using Virtual lab.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			2				1			2	1
	CO2	3	2			2				1			2	1

FOUNDATIONS OF ENGINEERING MATHEMATICS-I (For III Semester Lateral Entry students only)			
Contact Hours/ Week:	3:0:0:0	Credits:	00
Total Lecture Hours:	40 Hours	CIE Marks:	100
Course Code:	P3MATDIP	SEE Marks:	00

Course objectives:

This course will enable students to:

1.	Familiarize the importance of differential calculus.
2.	Familiarize the importance of calculus associated with one variable and multivariable arising in engineering.
3.	Analyze and solve engineering problems by applying Ordinary Differential Equations.

Unit I: Differential Calculus-I

Polar curves: angle between the radius vector and tangent, angle of intersection of polar curves. Pedal equation for polar curves. Curvature and radius of curvature in pedal form. (Without proof)

(8 Hours)**Unit II: Partial differentiation**

Partial derivatives, Total derivatives, differentiation of composite functions. Jacobians.

(8 Hours)**Unit III: Series Expansion and Application**

Taylor's and Maclaurin's series expansions for one variable (**statement only**). Indeterminate forms L' Hospital Rule (without proof)
(Only $\frac{0}{0}, \frac{\infty}{\infty}, 0 \times \infty$ and $\infty - \infty$ form)

(8 Hours)**Unit IV: Differential Equations of I Order**

Solution of first order and first degree differential equations: Variable Separable, Linear differential equations and Exact differential equations

(8 Hours)**Unit V: Differential Equations of higher order**

Solution of second and higher order equations with constant coefficients by inverse differential operator method, method of variation of parameters.

(8 Hours)

TEXT BOOKS		
1	Erwin Kreyzig	Advanced Engineering Mathematics”, 10 th edition, Wiley Publications, 2016. ISBN: 9788126508273.
2	B. S. Grewal	“Higher Engineering Mathematics”, 43 rd edition, Khanna Publications, 2015. ISBN;9788174091955.

REFERENCE BOOKS		
1	Maurice D. Weir, Joel R. Hass and George B. Thomas	“Thomas’ calculus: Early Transcendental”, 12 th edition, Pearson Education, 2016. ISBN: 978078024269.
2	Ramana .B.V	Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017, ISBN: 9780070634190.
3	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, McGraw – Hill Book Co., New York, 6th Ed., 2017, 9780070722064.
4	Louis A. Pipes and Lawrence R. Harvill	“Applied Mathematics for Engineers and Physicists”, 3 rd edition, McGraw Hill, 2014. ISBN: 9780486779515.
5	Peter V.O ’Neil	“Advanced Engineering Mathematics”, 7 th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 9788131503102.

IV SEM SYLLABUS

MATHEMATICS FOR COMMUNICATION

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	:P4EC1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Introduce students to concept of probability theory
2.	Apply random variable theory to analyze real world systems

UNIT I

Introduction, A Speech recognition system, A communication network, A Radar System, Introduction to Probability Theory: Experiments, sample space, Events, Axioms, Joint and conditional probabilities,. Baye's Theorem, Independence, Discrete Random Variables, Cumulative distribution function (CDF), Probability density function (PDF), Standard random variables, Gaussian RV, Uniform RV, Binomial RV, Poisson RV. Engineering application-An optical communication system.

9 Hours

UNIT II

Operations on a Single R V: Expected value, Expected value of functions of Random variables, Moments, Central Moments, Transformation of Random variables, Engineering application-Scalar quantization, Discrete binary source, Entropy and source coding.

8 Hours

UNIT III

Hypothesis Testing Error probabilities, ML and MAP decision rules, Soft Decisions, Signal Space Concepts, Representing signals as vectors, Modeling WGN in signal space, Hypothesis testing in signal space

8 Hours

UNIT IV	
Pairs of Random variables, Joint Cumulative distribution function, Joint Probability density function, Joint probability mass functions, Expected values involving pairs of Random variables, Independent Random variables, Jointly Gaussian Random variables. Engineering application-Mutual information, Channel capacity and channel coding Multiple Random Variables: JPDF, JCDF, and JPMF, Expected value involving multiple Random variables, Gaussian Random variable in multiple dimensions.	
9 Hours	

UNIT V	
Random Process: Definition and characterization, Mathematical tools for studying Random Processes, Stationary and Ergodicity, Properties of Autocorrelation function and Power spectral density, White noise process, Example Processes: Markov processes, Gaussian Processes.	
8 Hours	

TEXT BOOKS		
1	S L Miller and D C Childers	Probability and Random processes: with applications to Signal processing and communication Academic Press/ Elsevier, 2 nd Edition, 2014 (Chapter 1,2,3,4,5,6,and 8)
2	Upamanyu Madhow	Introduction to Communication Systems, Cambridge University Press, 2014. (Chapter 5, 6.1-6.2.3)

REFERENCE BOOKS		
1	A. Papoullis and S U Pillai	Probability, Random variables and stochastic processes McGraw Hill, 4 th Edition, 2002.
2	Peyton Z Peebles	Probability, Random variables and Random signal principles TMH, 4 th Edition 2007.
3	H Stark and Woods	Probability, statistics and random processes for engineers, Pearson 2012.

E-Resources: (Web links and video Lectures)

1. <https://archive.nptel.ac.in/noc/courses/noc15/SEM2/noc15-ec07/>
2. <https://www.youtube.com/watch?v=wMflxR3KsXg>

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Illustrate the knowledge of basics of probability and random variable theory to represent uncertainty (variability)
CO2	Identify parameters and use them to analyze randomness in data
CO3	Use hypothesis testing to perform detection of signal
CO4	Represent and analyze natural phenomena using multidimensional random
CO5	Model real world systems/applications using random processes

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			1			2	2		1	3	
	CO2	2	2			1			2	2		1	2	2
	CO3	2	2			1			2	2		1	2	2
	CO4	2	2			1			2	2		1	2	2
	CO5	2	2	2		1			2	2			2	2

ARM MICROCONTROLLER

Contact Hours/ Week:	3+0+2	Credits:	4
Total Lecture Hours:	42	CIE Marks:	50
Total Practical Hours:	28	SEE Marks:	50
Sub. Code:	P4ECI1		

Course objectives:

This course will enable students to:

1.	To provide basic understanding of ARM processor and peripherals.
2.	To provide efficient solutions to real life problems using ARM architecture.
3.	To provide a holistic view of ARM architecture, cache, MMUs

UNIT I

ARM Embedded Systems: Harvard and VonNeumann Architecture, CISC vs RISC, RISC design philosophy, ARM design philosophy, embedded system hardware, embedded system software., ARM7TDMI processor core diagram.

8 Hours

UNIT II

ARM Processor Fundamentals: ARM Data flow Model, Processor Operating States, Memory formats: Big endian and Little endian formats, Data types, Operating Modes, Registers – ARM state register set and Thumb state register set, the relationship between ARM state and Thumb state registers, Program Status Registers, Exceptions, Interrupt latencies, Reset, Pipeline.

9 Hours

UNIT III	
LPC214X ARM-based microcontroller: Features of LPC214x Microcontroller, LPC 214x block diagram, Memory Maps. Register description and C-programming of GPIO; ADC. Interfacing LED, Switch, Push button keys to LPC214x microcontroller.	
8 Hours	
UNIT IV	
Caches: The Memory Hierarchy and Cache Memory, Cache Architecture Cache Policy, concepts of Flushing and Cleaning Cache Memory, concepts of Cache Lockdown. Memory Protection Units: Protected Regions, concept of access permission.	
9 Hours	

UNIT V	
Memory Management Units: How Virtual Memory Works, Details of the ARM MMU, Page Tables, The Translation Lookaside Buffer, Domains and Memory Access Permission, The Caches and Write Buffer.	
8 Hours	

TEXT BOOKS		
1	Andrew N. Sloss, Dominic Symes and Chris Wright	ARM System Developer's Guide – Designing and Optimizing System Software, Elsevier 2004.

REFERENCE BOOKS		
1	Shibhu K.V	Introduction to Embedded Systems, TMH, 2 nd Edition, 2017.
2	ARM7TDMI	Datasheet
3	UM10139 LPC214x User manual	

E-resources:	
1	https://archive.nptel.ac.in/courses/117/106/117106111/
2	https://archive.nptel.ac.in/courses/106/105/106105193/
3	https://onlinecourses.nptel.ac.in/noc22_cs93/preview

Course Outcomes:	
Upon completion of this course the student will be able to:	
CO1	Identify and analyze typical hardware and software technologies that surround an ARM controller.
CO2	Analyse the programmer's model of the ARM controller.
CO3	Analyse the functionalities and Design software solutions using ADC, GPIO for ARM based Microcontroller-LPC 214x
CO4	Illustrate things a cache memory can do to make programs on ARM controller run faster.
CO5	Analyze functionality of ARM memory management units and Memory Protection Units.
CO6	Demonstrate the ability to provide efficient solutions for complex engineering problems using Embedded C in the area of ARM controllers individually and working in a team (CO for laboratory).

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COS	C01	3	2			1							2	
	C02	3	2										1	
	C03	3	2			1							1	1
	C04	3	2										1	
	C05	2	1										1	
	C06	3	2	1		1				1		1	1	1

Integrated Lab Component (2 Hours/Week) (28 Hrs)

Sl.no	PROGRAMS
1	Develop a program for addition/ subtraction/multiplication/sorting of numbers
2	Develop a program to generate square wave / sine wave using DAC of LPC2148
3	Develop a program to generate triangular/Staircase wave using DAC of LPC2148
4	Develop a program for Flashing / alternative Flashing LED
5	Develop a program for binary counting using LED
6	ABL activity
7	Develop a program to turn on LED whenever a push button is pressed and sound the alarm
8	Develop a program to convert given analog voltage to digital value
9	Formative lab test -1
10	Develop a program to generate a square wave on a GPIO pin when a key is pressed and stop whenever key is released
11	Develop a program to interface a DC motor and rotate it in clockwise and anticlockwise direction.
12	Develop a program to interface LCD unit and display a message.
13	Develop a program to display the key pressed from keypad over a 16X2 LCD using LPC2148

Open-Ended Experiments:

1. Design a system that monitors environmental conditions (temperature and light) and takes appropriate actions automatically.

Problem Statement: Develop a system that displays real-time temperature and light intensity on the LCD and triggers the buzzer if temperature exceeds certain limit and turn on Fan. Also detect the day/night condition and turns on light during night.

2. Design a multi-functional system that controls devices and provides basic security using user input.

Problem Statement: Develop a system that gets commands from the user to operate the light, fan and door in home. In case of wrong command, give security alerts on invalid access.

ENGINEERING ELECTROMAGNETICS AND MICROWAVE ENGINEERING

Contact Hours/ Week:	: 3+2+0	Credits:	4
Total Lecture Hours:	: 42	CIE Marks:	50
Total Tutorial Hours	: 28	SEE Marks:	50
Sub. Code:	: P4EC2		

Course objectives:

This course will enable students to:

1.	Understand the Electrostatic field, Magneto-static field & Time-varying fields.
2.	Learn boundary conditions & boundary value problems.
3.	Understand Maxwell's equations.
4.	Acquire knowledge of dielectrics and its properties
5.	Learn the Electromagnetic waves traveling through free space, lossy dielectric, lossless dielectric and conductors.
6.	Design of various filters using Butterworth, Stepped impedance and Kuroda's identity using microstrip technology.

UNIT I

Electrostatics: Introduction, Qualitative analysis of Force, Electric Field Intensity, Electric Flux Density, Work Done in an electric field, Electric Potential, Relation between E and D, E and V, Current and Current Density, Boundary Conditions (Dielectric-Dielectric only).

10 Hours**UNIT II**

Magnetostatic and Maxwell's equations: Qualitative analysis of Magnetic field intensity, Magnetic Flux Density, Magnetic Potential, Relation between Magnetic Field Intensity and Magnetic Flux Density, Faraday's law, Transformer & Motional EMFs, Displacement current, Modified Ampere's

law, Time- varying Maxwell's equations in point & integral forms, Time harmonic Maxwell's equations.

8 Hours

UNIT III

Electromagnetic waves and Transmission Lines: Uniform plane wave (UPW) - properties and transverse nature, loss tangent, skin-effect, Poynting vector. Transmission line equivalent lumped element circuit and parameters, concept of lumped elements and distributed elements, Line equations (No Derivation), Lossless line, Distortion less line, Input impedance (qualitative analysis only; no derivation), reflection coefficient, transmission coefficient, SWR, standing wave patterns. Applications of fields, lines and waves, polarization.

8 Hours

UNIT IV

Introduction to Microwave Engineering and Planar Transmission Lines: Introduction to Microwave Spectrum and Bands, Applications of microwaves; S matrix representation of Two-port & multi-port network, S-parameter properties (No proof), Smith Chart and Applications. Microstrip line (geometry, design equations), Strip line, Slot lines, Co-Planar Wave Guide - geometry only.

7 Hours

UNIT V

Microwave Circuits: Microwave Filters: Stepped impedance and Kuroda's identity method, Power Dividers: Wilkinson Power Divider, 90 Degree Branch Line Coupler, Solve Basic Transmission line problems and Single stub matching using Smith Chart.

9 Hours

TEXT BOOKS

1	Matthew N. O. Sadiku and S.V. Kulkarni	Principles of Electromagnetics, Oxford University Press India, 6 th Edition, 2019.
2	David M Pozar	Microwave Engineering, John Wiley & Sons, 4 th Edition, 2021.

REFERENCE BOOKS

1	W.H. Hayt. J.A. Buck & M Jaleel Akhtar	Engineering Electromagnetics, Tata McGraw – Hill, 9th Edition, 2020.
2	Joseph Edminster	Electromagnetics, Schaum's Outline Series, Tata McGraw-Hill, 4th Edition, 2013.
3	Edward C Jordan and Keith G Balmain	Electromagnetic Waves and Radiating Systems, Prentice-Hall of India, 2nd Edition, 2002.

E-RESOURCES

<https://sites.google.com/iittp.ac.in/naveenkp/teaching/lectures>

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Analyze the relationship between electric field and potential.
CO2	Identify, apply Maxwell's equations for analysis of static and time varying fields.
CO3	Analyze the wave propagation in different medium based on its parameters.
CO4	Demonstrate the working of Microwave passive devices by analyzing S-Matrix.
CO5	Design and Analyze Micro Strip Lines and Microwave Filters and Power Divider Circuits.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	2	2	1					1	1			2	1
	CO2	2	2	1					1	1			2	1
	CO3	2	2	1					1	1			2	1
	CO4	2	2	1					1	1			2	1
	CO5	2	2	1					1	1			2	1

COMMUNICATION SYSTEMS-I

Contact Hours/ Week:	: 3+0+0	Credits:	3
Total Lecture Hours:	: 42	CIE Marks:	50
Sub. Code:	: P4EC4	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the basic representation of pass band signals.
2.	Understand analog modulation and demodulation techniques.
3.	Understand the sampling process and pulse modulation techniques.
4.	Understand different digital modulation and demodulation techniques and its applications.

UNIT I

Representation of Baseband and Bandpass signals: Analog vs Digital Communication, Review of Fourier transform, Energy spectral density and bandwidth, Baseband and Passband Signals, The structure of a passband signal: Time domain relationships, Frequency domain relationships, Complex baseband equivalent of passband filtering, General comments on complex baseband.

9 Hours

UNIT II

Analog modulation and demodulation: Double sideband suppressed carrier modulation, Conventional AM, Single-sideband modulation, Vestigial-sideband modulation Quadrature amplitude modulation, Concept synthesis for AM. Frequency modulation, Limiter discriminator

demodulation, FM spectrum, The Superheterodyne receiver, The phase locked loop, PLL applications, FM radio.
9 Hours
UNIT III
Sampling and Quantization: Sampling Theorem, Time division multiplexing, Digital Pulse modulation: Pulse amplitude modulation, Pulse Code Modulation, Pulse Width Modulation, Quantization noise, Companding and coding techniques, Robust quantization, Delta modulation.
8 Hours

UNIT IV
Digital Modulation Techniques: Signal Constellations, Bandwidth occupancy, Power Spectral Density, PSD of a linearly modulated signal. Design of band limited channels, Nyquist criterion for ISI avoidance, Bandwidth efficiency, power bandwidth trade-offs.
8 Hours

UNIT V
Optimum Demodulation: Optimal reception in AWGN, Geometry of the ML decision rule. Performance analysis of ML reception: The geometry of errors, Performance with binary signalling and M-ary signalling, Performance analysis for M-ary orthogonal modulation, Bit error probability.
8 Hours

TEXT BOOKS		
1	Upamanyu Madhow	Introduction to Communication Systems, Cambridge University Press, 2014.
2	Simon Haykin	Digital Communications, John Wiley, 2012.

REFERENCE BOOKS

1	K Sam Shanmugam	Digital and Analog Communication Systems, John Wiley, 2011.
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E-RESOURCES

1	https://sites.google.com/iittp.ac.in/naveenkp/teaching/lectures
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Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Develop the complex baseband representation of passband signals.
CO2	Analyse analog modulation and demodulation techniques.
CO3	Compute digital equivalent of the analog signal and analyse with different sampling rates.
CO4	Evaluate digital modulation techniques using different parameters.
CO5	Compare ML and MAP decision techniques with performance analysis.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2	1					1	1			2	1
	CO2	3	2						1	1			2	1
	CO3	3	2	1					1	1			2	1
	CO4	3	2	1					1	1			2	1
	CO5	3	2						1	1			2	1

COMMUNICATION SYSTEMS-1 LAB

Contact Hours/ Week:	: 0+0+2	Credits:	1
Total Practical Hours:	: 28	CIE Marks:	50
Sub. Code:	: P4ECL1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Understand the process of modulation and demodulation in communication systems.
2.	Understand the sampling and quantization process.

I. Rig Up Experiments:

1. Design and demonstrate the generation and demodulation of standard amplitude modulated signal.
2. Design and demonstrate frequency modulation system.
3. Design and demonstrate pulse width modulation.
4. Verify sampling theorem using Flat Top Samples
5. Design and demonstrate generation and detection of Binary Amplitude Shift Keying
6. Design and demonstrate generation of Binary Phase Shift Keying

II. Simulation Experiments using Matlab/Scilab/Octave/SDR:

1. FM transmitter
2. FM receiver
3. Frequency Translator
4. Eye diagram plot
5. Generation of ASK, PSK and FSK
6. Bit error rate comparison for M-ary PSK

III. Open Ended Experiments:

1. Develop AM radio using super heterodyne receiver.
2. Develop FM stereo transmitter and receiver.
3. Develop AM, DSBSC, SSBSC and VSBSC transmitters and compare the power requirements.
4. Design FM demodulator using phase locked loop.
5. Design frequency synthesizer using phase locked loop.
6. Non uniform quantization using A-law and μ -law.
7. Develop Delta modulator and demodulator
8. Develop Pulse code modulation system
9. Develop pulse position modulator and demodulator

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Demonstrate generation and detection of analog and digital modulated signals.
CO2	Design and demonstrate pulse modulation systems.
CO3	Analyze the effect of sampling frequency for signal discretization.
CO4	Perform signal quantization.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
C O S	CO1	3	3	2		3			2	2			3	2
	CO2	3	3	2		3			2	2			3	2
	CO3	3	3	2		3			2	2			3	2
	CO4	3	3	2		3			2	2			3	2

ADVANCED TECHNICAL TRAINING-C++ LAB

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P4ECA1	SEE Marks:	50

Course objectives:

This course will enable students to:

1.	Build the logic for a given problem statement by using algorithms using fundamental concepts of the Programming Language C such as conditional statements, looping constructs, division, mod operations and string manipulation.
2.	Implement the Data Structures such as Stacks, Queues, Lists, and Trees using C Programming language.
3.	Implement the fundamental concepts of Object Oriented Programming Concepts, such as Classes, Objects, Abstraction, Encapsulation, Polymorphism, Constructors, Over Loading and Over Riding.

Topics to be covered:

1. Structure of a 'C' Program
 - a. Main Function
 - b. Input & Output
 - c. C Tokens
2. Keyword and Identifiers
3. Operators
4. Variables
5. Control Statements
 - a. Conditional Statements
 - If
 - If-else
 - Simple
 - Nested
 - Multiple
 - Switch

b. Looping Statements

- while
- do-while
- for

6. Arrays

- Single Dimensional
- Two Dimensional
- String as Character Arrays

7. Functions and Recursive Functions

8. Pointers

9. Structures and Unions

10. Enumerations

11. Files

12. Introduction to Data Structures

- Space Complexity
- Time Complexity

13. Classification of data structures

- Linear Data structures
- Non-Linear Data Structures

14. Array Versus Linked List

15. Linked List

- Single Linked List
- Double Linked List
- Circular Linked List

16. Stack

- Push
- Pop

17. Queue

- Enqueue
- Dequeue

18. Searching Techniques

- Linear Search
 - Binary Search
-

19. Sorting Techniques

- Bubble Sort
- Insertion Sort
- Selection Sort
- Merge Sort
- Quick Sort

20. Tree

- Pre-Order
- In-Order
- Post-Order

21. Graph

- DFS
- BFS

22. Introduction to Object Oriented Programming and C++

23. Difference between C and C++

24. C++ Programming Structures and Input/output Functions

25. OOPS Concepts

- Class and Object
- Abstraction
- Encapsulation
- Inheritance
- Polymorphism

26. Implementation of the OOPS Concepts

Course Outcomes:

After the completion of this course, students will be able to :

CO1	Design and develop solutions for particular programming problems using the fundamental concepts of C Programming.
CO2	Implement different data structures like Stacks and Queues using static and dynamic memory allocation techniques.
CO3	Design & Implement Object oriented concepts of C++ programming such as Classes, Objects, Inheritance, polymorphism for a given problem statement.

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	2	2			3			2	2			2	2
	CO2	2	2			3			2	2			2	2
	CO3	2	2			3			2	2			2	2

COMMUNICATION APPLICATIONS USING PYTHON

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P4ECA2	SEE Marks:	50

Prerequisites: Basic Knowledge of Python Programming, Signals and systems, Communication systems-1.

Course objectives:

This course will enable students to:

- | | |
|----|--|
| 1. | Practice various computing strategies for Python-based solutions to real world problems. |
| 2. | Use Python data structures-lists, tuples, dictionaries. |

List of experiments:

1. Write a Python program to find rank, determinant and trace of an array, eigenvalues of matrices, matrix and vector products (dot, inner, outer, product), matrix exponentiation, solve a linear matrix equation or system of linear scalar equations.
2. Write a Python program to synthesize a compound signal by creating SinSignal and CosSignal objects and adding them up. Compute its Spectrum and plot it.
3. Write a Python program to perform convolution of a signal with a series of impulses.
4. Write a Python program to generate noise, plot its spectrum/normal probability plot and categorize based on the distribution.
5. Write a Python program to plot auto correlation of different kind of noises.
6. Write a Python program to calculate the pitch of periodic signal.

7. Write a Python program to plot (i) Bar plots (ii) Histograms (iii) Line plots (iv) Scatter plots using Pandas.
 - b) Demonstrate use of groupby() method.
 - c) Demonstrate pandas Merging, Joining and Concatenating
 - d) Create data frames from csv and excel files.
8. Write a Python program to create a white image using NumPy b) Convert a NumPy array to an image and Convert images to NumPy array
 - c) Perform Sorting, Searching and Counting using Numpy methods.
 - d) Demonstrate the use of the reshape () method.
9. Write a Python program to analyze the implications of sampling theorem at variable sampling rates for a sine wave input signal.
10. Write a Python program to transmit / receive data through cloud using socket programming (Server-Client model).

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Develop algorithms to perform signal and image processing applications using Python.
CO2	Develop algorithms to compute various characteristics of a noisy Signal.
CO3	Develop applications related to data analytics.
CO4	Analyze signal spectrum in frequency domain.
CO5	Build data transmission using socket programming in python.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	3	2		3			2	2			3	2
	CO2	3	3	2		3			2	2			3	2
	CO3	3	3	2		3			2	2			3	2
	CO4	3	2			3			2	2			3	2
	CO5	3	2			3			2	2			3	2

ADVANCED DIGITAL DESIGN USING SYSTEM VERILOG

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P4ECA3	SEE Marks:	50

Course objectives:

This course will enable students to:

- | | |
|----|---|
| 1. | Learn the usage of modern tools to analyze digital VLSI circuits. |
| 2. | Design and test digital VLSI systems. |

List of experiments (using Modelsim/Cadence)

1. Design counting 0s in 10 bit input
2. Design a 6 bit comparator using structural approach
3. Design 5 bit Binary to BCD converter using dataflow
4. Design signed subtraction using dataflow
5. Design a comparator with 4 outputs (gt, aeq, eq, lt)
6. Design a BCD to excess-3 converter
7. Design a counter for 24 hours format
8. Design mod5-mod7-mod9 sandwich counter
9. Design an elevator for four floor building
10. Design a circuit to detect a name sequence

E-Resources:

1	https://www.youtube.com/watch?v=NCrlyaxMA8&list
2	https://www.youtube.com/watch?v=y_hEbgWWuQs

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Design and analyse combinational circuits using system Verilog.
CO2	Design and test sequential circuits using system Verilog.

Course Articulation Matrix

		POs											PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2			1			2			1	1	1
	CO2	3	2			1			2			1	1	

INDUSTRIAL IOT

Contact Hours/ Week:	0+0+2	Credits:	1
Total Practical Hours:	28	CIE Marks:	50
Sub. Code:	P4ECA4	SEE Marks:	50

Course objectives:

This course will enable students to:

- | | |
|----|---|
| 1. | Develop the skill of usage of modern tools to interface sensors and actuators. |
| 2. | Design and test uploading and retrieval of sensor data to and from cloud database |

List of experiments:

1. Study the fundamental of IOT software and components.
2. Familiarization with Arduino/Raspberry Pi and perform necessary software.
3. To interface LED/Buzzer with Arduino/Raspberry Pi and write a program to TURN on LED for one second after every five second.
4. To turn on LEDs when push button is pressed and also to alarm the sound using buzzer.
5. Program to interface LDR and to sound the buzzer.
6. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed or at sensor detection.
7. Program to interface LCD unit and to display messages.
8. To interface DHT11 sensor with Arduino/Raspberry Pi and write a program to print temperature and humidity readings.

9. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON motor when push button is pressed.
10. To interface OLED/ LCD with Arduino/Raspberry Pi and write a program to print temperature and humidity readings on it.
11. Program to calculate the distance between the object and the ultrasonic sensor using Arduino/Raspberry Pi.
12. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data to smart phone using Blue tooth.
13. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON and OFF when “1” of “0” is received from smart phone using Blue tooth.
14. Write a program on Arduino/Raspberry Pi to upload temperature and humidity readings to things speak cloud.
15. Write a program on Arduino/Raspberry Pi to retrieve temperature and humidity readings from things speak cloud.

Course Outcomes:

Upon completion of this course the student will be able to:

CO1	Develop programs using Arduino/Raspberry Pi for interfacing sensors and actuators.
CO2	Develop programs in an IoT/Blue tooth environment to upload and download the sensor data to and from cloud/database.

Course Articulation Matrix

	POs												PSOs	
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	2	2		3			2			2		1
	CO2	3	2	2		3			2			2		1

BIOMEDICAL SIGNALS AND APPLICATIONS

Contact Hours/ Week:	: 1+0+0	Credits:	1
Total Lecture Hours:	: 15	CIE Marks:	50
Sub. Code:	: P4ECB1	SEE Marks:	50

Course Objectives: The objectives of the course is to enable student to			
1.	Understand measurement, characteristics, working principle and application of biomedical sensors.		
2.	Identify smart sensors, sensor interface standards for wearable device applications.		

UNIT I			
Human Physiological Systems:			
Anatomy and physiology of: Nervous System – Synapses, Action Potential, and EEG, Circulatory System- ECG signal origin, parameters and Characteristics, and Respiratory System – Photoplethysmography.			
			5 Hours

UNIT II			
Acquisition of Biomedical Signals for CNS and Circulatory Systems:			
The Electrocardiogram-The heart, The electrical system of the heart, ECG electrode system, ECG signal acquisition, The Electroencephalogram, EEG electrode systems and its acquisition. Case studies: Portable ECG Machine, EEG measurement system			
			5 Hours

UNIT III			
Applications of Biomedical Engineering:			
Introduction to the world of wearable technology, ethics and standards (ICMR Guidelines), Wearable inertial sensors-Accelerometers, Gyroscopic sensors and magnetic sensors, Applications: Fall risk assessment, Gait analysis, wearable ECG and EEG devices.			
			5 Hours

Text books:

1	Gerard J. Tortora and Bryan H. Derrickson	Principles of Anatomy and Physiology, 16th Edition, John Wiley & Sons, 2021.
2	Rangaraj M. Rangayyan	Biomedical Signal Analysis A Case-Study Approach, IEEE Press, John Wiley & Sons, INC. McGraw-Hill Publishing, 1st edition, 2002.

Reference Books:

1	R.S.Khandpur	Biomedical instrumentation: Technology and applications, Tata McGraw-Hill Publishing, 1 st edition, 2004.
2	L. Cromwell, FJ Weibell and EA Pfeiffer	Biomedical instrumentation and measurements, Prentice-Hall Inc., New Jersey, USA, 2nd edition, 1990.
3	Subhas c. Mukhopadhyay	Wearable Electronics Sensors for safe and healthy living, Springer International Publishing, 2015
4	Edward Sazonov	Wearable Sensors: Fundamentals, Implementation and Applications, Neuman Academic Press, 1st Edition, 2014.

Course Outcomes:

Upon Completion of this Course the student will be able to:

CO1	Analyze bioelectrical signals and measure physiological parameters.
CO2	Identify different ECG and EEG electrode systems and their methods of signal acquisition.
CO3	Identify wearable sensors for different healthcare applications.

Course Articulation Matrix

	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3				2	1	1		2			3	1
	CO2	3				2	1	1		2			3	1
	CO3	3				2	1	1		2			3	1

AI APPLICATIONS IN ELECTRONICS AND COMMUNICATION ENGINEERING

Contact Hours/ Week:	: 1+0+0	Credits:	1
Total Lecture Hours:	: 15	CIE Marks:	50
Sub. Code:	: P4EC3	SEE Marks:	50

Prerequisites: Linear Algebra

Course objectives:

This course will enable students to:

1.	Introduce AI/ML fundamentals relevant to ECE domains
2.	Explore AI applications in Signal Processing, Communication, VLSI, and Embedded Systems.
3.	Provide hands-on exposure to AI tools used in ECE workflows
4.	Enable students to identify AI-driven solutions for real-world ECE problems.

UNIT I

Foundations of AI/ML for ECE: Introduction to AI, ML, DL — key differences; relevance to ECE domain.

Types of learning (supervised, unsupervised, reinforcement); basic neural network architecture (perceptron, MLP).

Overview of DNNs and their suitability for signal/image data in ECE

5 Hours

UNIT II

AI in VLSI Design & Embedded Systems: AI in EDA tools — placement, routing, floor planning (RL-based chip design).

AI in fault detection, ATPG, and power optimization in VLSI.

TinyML and edge AI — deploying ML models on microcontrollers; predictive maintenance in IoT devices.

5 Hours

UNIT III

AI in Signal Processing & Communication Systems:

AI-based noise filtering, enhancement, and classification

AI in 5G/6G networks: channel estimation, beamforming, spectrum sensing (cognitive radio).

Case study: AI in biomedical electronics (ECG/EEG analysis), robotics, human-machine interfaces; Estimation and network optimization

5 Hours

REFERENCE BOOKS

1	Ian Goodfellow YoshuaBengio, Aaron Courville	Deep Learning, MIT Press, 2016.
2	Sandro Skansi	Introduction to Deep Learning: From Logical Calculus to Artificial Intelligence, Springer, 2018.
3	Selected papers from IEEE Transactions on IoT, Wireless Communications, Artificial Intelligence and Circuits, Systems and Signal Processing	

Course Outcomes:

Upon completion of this course the student will be able to:

CO1:	Explain core AI concepts and map them to EC domain specific problem.
CO2:	Understand how AI accelerates chip design and helps in developing intelligent embedded systems.
CO3:	Understand application of AI in signal processing and communication areas.

Course Articulation Matrix

	POs											PSOs		
		1	2	3	4	5	6	7	8	9	10	11	1	2
COs	CO1	3	1			2				2	2	2	2	2
	CO2	3	1			2				2	2	2	2	2
	CO3	3	1			2				2	2	2	2	2

Tools/Platforms

- Python (NumPy, TensorFlow/PyTorch, Scikit-learn)
- MATLAB (Deep Learning Toolbox, Communications Toolbox)
- Open datasets: RadioML (modulation classification), PhysioNet (ECG/EEG)

FOUNDATIONS OF ENGINEERING MATHEMATICS-II (For IV Semester Lateral Entry students only)

Contact Hours/ Week:	3:0:0:0	Credits:	00
Total Lecture Hours:	40 Hours	CIE Marks:	100
Course Code:	P4MATDIP	SEE Marks:	00

Course objectives:

This course will enable students to:

1.	Develop the numerical schemes to solve algebraic, transcendental and differential Equations.
2.	Familiarize the importance of Integral calculus and Vector calculus.
3.	Analyze the engineering problems applying Partial Differential Equations

Unit I: Elementary Numerical Methods - I

Solution of polynomial and transcendental equations - Newton-Raphson method (only formula) - Illustrative examples. Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae, Newton's divided difference and Lagrange's formulae (All formulae without proof).

(8 Hours)

Unit II: Numerical Integration & Numerical Solution of Differential Equations

Numerical integration: Trapezoidal, Simpson's $1/3^{\text{rd}}$, Simpson's $3/8^{\text{th}}$ rule and Weddle's rule. Numerical solution of ordinary differential equations of first order and first degree – Taylor's series method, Modified Euler's method, Runge-Kutta method of fourth order and Milne's predictor-corrector method.

(8 Hours)

Unit III: Vector Calculus

Vector Differentiation: scalar and vector fields, Gradient, directional derivative, divergence, curl-physical interpretation; solenoidal and irrotational vector fields-illustrative problems.

(8 Hours)

Unit IV: Partial Differential Equations

Formation of PDEs by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivatives with respect to one independent variable only.

(8 Hours)

Unit V: Integral Calculus

Multiple integrals – Evaluation of double and triple Integrals, **Beta and Gamma functions:** Definition, relation between Beta and Gamma functions and simple problems.

(8 Hours)

TEXT BOOKS		
1	Erwin Kreyzig	Advanced Engineering Mathematics”, 10 th edition, Wiley Publications, 2016. ISBN: 9788126508273.
2	B. S. Grewal	“Higher Engineering Mathematics”, 43 rd edition, Khanna Publications, 2015. ISBN:9788174091955.
3	M.K. Jain, S.R.K. Iyengar and R.K. Jain	Numerical Methods for Scientific and Engineering Computation, New Age International Publishers, 8 th Ed., 2022. ISBN: 9788183893732

REFERENCE BOOKS		
1	Maurice D. Weir, Joel R. Hass and George B. Thomas	“Thomas’ calculus: Early Transcendental”, 12 th edition, Pearson Education, 2016. ISBN: 978078024269.
2	Ramana .B.V	Higher Engineering Mathematics, McGraw-Hill Education, 11th Ed., 2017, ISBN: 9780070634190.
3	C.Ray Wylie, Louis. C. Barrett	Advanced Engineering Mathematics, McGraw – Hill Book Co., New York, 6th Ed., 2017, 9780070722064.
4	Louis A. Pipes and Lawrence R. Harvill	“Applied Mathematics for Engineers and Physicists”, 3 rd Edition, McGraw Hill, 2014. ISBN: 9780486779515.
5	Peter V.O ’Neil	“Advanced Engineering Mathematics”, 7 th edition, CENGAGE Learning India Pvt. Ltd. Publishers, 2012. ISBN; 9788131503102.