Dr. AMBEDKAR INSTITUTE OF TECHNOLOGY

(An Autonomous Institute affiliated to VTU, Accredited by NAAC with 'A' grade)

BDA Outer Ring Road, Mallathalli,Bengaluru-56

Board Of Studies 2025-26

Approved
UG Scheme and Syllabus
For
Academic Year 2025-26

Submitted by

Department of Electronics and Communication Engineering

To

DEAN (Academic)

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Scheme of Teaching and Examination for I/II Semester B.E. CBCS 2022, Academic Year-2025-26
2022 Scheme for ECE/EI/ET
Applicable to 2025 Batch

Chemistry Cycle **SEMESTER: I**

Sl. No.	Course Category	Course Code	Course Title	Teaching Department	Teaching Hours/Week					Examination				Credits
					L	T	P	SDA	Total	Duration(Hrs)	CIE Marks	SEE Marks	Total Marks	
1	ASC(IC)	MAU101D	Mathematics- I	Maths	2	2	2	0	4+2	03	50	50	100	04
2	ASC(IC)	CHU102B	Applied Chemistry	Chemistry	3	0	2	0	3+2	03	50	50	100	04
3	ESC	MED103	Computer Aided Engineering Drawing	Civil/Mech.	2	2	0	0	3	03	50	50	100	03
4	ESC-1	ESX104x	Engineering Science Course-I	Respective Engg. dept	3	0	0	0	3	03	50	50	100	03
5	ETC-1	ETT105x	Programming Language Course - I	Any Engg. Dept	3	0	0	0	3	03	50	50	100	03
6	AEC	ENT106	Communicative English	Humanities	1	0	0	0	1	02	50	50	100	01
7	HSS	CIT1O7	Constitution of India	Humanities	1	0	0	0	1	02	50	50	100	01
8	HSS	SFH108	Scientific Foundation of Health	Any dept.	1	0	0	0	1	02	50	50	100	01
9	MC	CDN109	Career Development skill-I	Placement cell	2	0	0	0	2	-	50	---	---	NP/ PP
									Total	**25**		**450**	**400**	**800**	**20**

D/PSB- Teaching Department / Paper Setting Board, **SS**-Self Study, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSS**-Humanity and Social Science Course, **CIE** –Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

Credit Definition: 1-hour Lecture **(L)** per week=**1Credit** 2-hoursTutorial**(T)** per week=**1Credit** 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 12-14 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 12-15 hours of Teaching-Learning sessions

Student's Induction Program: Motivating (Inspiring) Activities under the Induction program – The main aim of the induction program is to provide newly admitted students a broad understanding of society, relationships, and values. Along with the knowledge and skill of his/her study, students' character needs to be nurtured as an essential quality by which he/she would understand and fulfill the responsibility as an engineer. The following activities are to be covered in 21 days. Physical Activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to Local areas, Familiarization with Department/Branch and Innovation, etc. For details, refer the ANNEXUREI of Induction Programs notification of the University published at the beginning of the 1st semester.

AICTE Activity Points to be earned by students admitted to B.E. day college program (For more details refer to Chapter 6, AICTE Activity Point Program, Model Internship Guidelines): Over and above the academic grades, every regular student admitted to the 4 years Degree program and every student entering 4 years Degree programs through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Program. Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, any time during the semester weekends, and holidays, as per the liking and convenience of the student from the year of entry to the program. However, the minimum hour's requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth Semester Grade Card shall be issued only after earning the required activity points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MAU101D Shall have the 03 hours of theory examination(SEE), however, practical sessions question shall be included in the theory question papers **#-**
CHU102B SEE shall have the 03 hours of theory examination), however, practical sessions question shall be included in the theory question papers.
ESC or ETC, of 03 credits Courses shall have only a theory component (L:T :P:S=3:0:0:0) or if the nature the of course required practical learning then the syllabus shall be designed as an Integrated course (L:T:P:S= 2:0:2:0). All **PLC** courses are Integrated courses.
All 01 Credit- courses shall have the SEE **of 02 hours duration and the pattern of the question paper shall be MCQ**

(ESC-I) Engineering Science Courses-I					(ETC-I) Emerging Technology Courses-I				
Code ESX104x	**Title**	**L**	**T**	**P**	**Code ETT105x**	**Title**	**L**	**T**	**P**
EST104A	Introduction to Civil Engineering	3	0	0	ETT1051	Introduction to Cyber Security	3	0	0
EST104B	Introduction to Electrical Engineering	3	0	0	ETT1052	Introduction to Internet of Things (IOT)	3	0	0
EST104C	Introduction to Electronics Engineering	3	0	0	ETT1053	Renewable Energy Sources	3	0	0
EST104D	Introduction to Mechanical Engineering	3	0	0	ETT1054	Waste Management	3	0	0
ESU104E	Introduction to C Programming	2	0	2	ETT1055	Green Buildings	3	0	0
					ETT1056	Smart Materials and Systems	3	0	0
					ETT1057	Introduction to Nano Technology	3	0	0
					ETT1058	Introduction to Sustainable Engineering	3	0	0
					ETT1059	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I					**Applied Science Course(ASC)**				
Code PLU105x	**Title**	**L**	**T**	**P**	**Code**	**Title**			
PLU105A	Introduction to Web Programming	2	0	2	**MAU101D**	Mathematics – I for EE stream			
PLU105B	Introduction to Python Programming	2	0	2	**CHU102B**	Applied Chemistry for EE stream			
PLU105C	Basics of JAVA programming	2	0	2					
PLU105D	Introduction to C++ Programming	2	0	2					
The course ESU104E: Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT									

- The student has to select one course from the ESC-I group.
- ME/AE/IEM stream Engineering Students shall opt for any one of the courses from the ESC-I group except, **22ESU104C - Introduction to Electronics Engineering**
- The students must opt for the courses from ESC group without repeating the course either 1st or 2nd semester
- The students must select one course from either ETC-I or PLC-I group.

- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa.

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Scheme of Teaching and Examination for I/II Semester B.E. CBCS 2022, Academic Year-2025-26
2022 Scheme: ECE/EI/ET
Applicable to 2025 Batch

Physics Cycle **SEMESTER : II**

Sl. No.	Course Category	Course Code	Course Title	Teaching Department	Teaching Hours/Week					Examination				Credits
					L	T	P	SDA	Total	Duration (Hrs)	CIE Marks	SEE Marks	Total Marks	
1	ASC(IC)	MAU201D	Mathematics	Maths	2	2	2	0	4+2	3	50	50	100	4
2	ASC(IC)	PHU202D	Applied Physics	Physics	3	0	2	0	3+2	3	50	50	100	4
3	ESC	ECT203	Basic Electronics	EEE	3	0	0	0	3	3	50	50	100	3
4	ESC-II	ESX204x	Engineering Science Course-II	Respective Enggdept	3	0	0	0	3	3	50	50	100	3
5	ETC-II	ETT205X	Emerging Technology Course - II	Any Engg. Dept	2	0	2	0	4	3	50	50	100	3
6	AEC	ENT206	Professional writing skill	Humanities	1	0	0	0	1	2	50	50	100	1
7	HSS	SKT207/ BKT207	Samskrutika/ Balake Kannada	Humanities	1	0	0	0	1	2	50	50	100	1
8	HSS	IDT208	Innovation and Design Thinking	Humanities	1	0	0	0	1	2	50	50	100	1
9	MC	CDN209	Career Development skill-II	Humanities	2	0	0	0	2	-	50	---	---	NP/ PP
				Total					**26**		**450**	**400**	**800**	**20**

TD/PSB- Teaching Department / Paper Setting Board, **SS**-Self Study, **ASC**-Applied Science Course, **ESC**- Engineering Science Courses, **ETC**- Emerging Technology Course, **AEC**- Ability Enhancement Course, **HSS**-Humanity and Social Science Course, **CIE** –Continuous Internal Evaluation, **SEE**- Semester End Examination, **IC** – Integrated Course (Theory Course Integrated with Practical Course)

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Student's Induction Program: Motivating (Inspiring) Activities under the Induction program – The main aim of the induction program is to provide newly admitted students a broad understanding of society, relationships, and values. Along with the knowledge and skill of his/her study, students' character needs to be nurtured as an essential quality by which he/she would understand and fulfill the responsibility as an engineer. The following activities are to be covered in 21 days. Physical Activity, Creative Arts, Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Visits to Local areas, Familiarization with Department/Branch and Innovation, etc. For details, refer the ANNEXUREI of Induction Programs notification of the University published at the beginning of the 1st semester.

AICTE Activity Points to be earned by students admitted to B.E. day college program (For more details refer to Chapter 6, AICTE Activity Point Program, Model Internship Guidelines): Over and above the academic grades, every regular student admitted to the 4 years Degree program and every student entering 4 years Degree programs through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Program. Students transferred from other Universities to the fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card. The activities can be spread over the years, any time during the semester weekends, and holidays, as per the liking and convenience of the student from the year of entry to the program. However, the minimum hour's requirement should be fulfilled. Activity Points (non-credit) do not affect SGPA/CGPA and shall not be considered for vertical progression. In case students fail to earn the prescribed activity Points, an Eighth Semester Grade Card shall be issued only after earning the required activity points. Students shall be admitted for the award of the degree only after the release of the Eighth semester Grade Card.

MAU101D Shall have the 03 hours of theory examination(SEE), however, practical sessions question shall be included in the theory question papers

#- PHU202D SEE shall have the 03 hours of theory examination), however, practical sessions question shall be included in the theory question papers.

ESC or ETC, of 03 credits Courses shall have only a theory component (L:T :P:S=3:0:0:0) or if the nature the of course required practical learning then the syllabus shall be designed as an Integrated course (L:T:P:S= 2:0:2:0). All **PLC** courses are Integrated courses.

All 01 Credit- courses shall have the SEE **of 02 hours duration and the pattern of the question paper shall be MCQ**

(ESC-II) Engineering Science Courses-II					(ETC-II) Emerging Technology Courses-II				
Code ESX104x	**Title**	**L**	**T**	**P**	**Code ETT105x**	**Title**	**L**	**T**	**P**
EST204A	Introduction to Civil Engineering	3	0	0	ETT2051	Introduction to Cyber Security	3	0	0
EST204B	Introduction to Electrical Engineering	3	0	0	ETT2052	Introduction to Internet of Things (IOT)	3	0	0
EST204C	Introduction to Electronics Engineering	3	0	0	ETT2053	Renewable Energy Sources	3	0	0
EST204D	Introduction to Mechanical Engineering	3	0	0	ETT2054	Waste Management	3	0	0
ESU204E	Introduction to C Programming	2	0	2	ETT2055	Green Buildings	3	0	0
					ETT2056	Smart Materials and Systems	3	0	0
					ETT2057	Introduction to Nano Technology	3	0	0
					ETT2058	Introduction to Sustainable Engineering	3	0	0
					ETT2059	Introduction to Embedded System	3	0	0
(PLC-I) Programming Language Courses-I					**Applied Science Course(ASC)**				
Code PLU105x	**Title**	**L**	**T**	**P**	**Code**	**Title**			
PLU205A	Introduction to Web Programming	2	0	2	**MAU201D**	Mathematics – I for EE/EC/EI/ET			
PLU205B	Introduction to Python Programming	2	0	2	**PHU202D**	Applied Physics for EE/EC/EI/ET			
PLU205C	Basics of JAVA programming	2	0	2					
PLU205D	Introduction to C++ Programming	2	0	2					
The course ESU104E: Introduction to C Programming, and all courses under PLC and ETC groups can be taught by faculty of ANY DEPARTMENT									

- The student has to select one course from the ESC-II group.
- ME/AE/IEM stream Engineering Students shall opt for any one of the courses from the ESC-II group except, **22ESU204C - Introduction to Electronics Engineering**
- The students have to opt for the courses from ESC group without repeating the course either 1st or 2nd semester
- The students must select one course from either ETC-II or PLC-II group.
- If students study the subject from ETC-I in 1st semester he/she has to select the course from PLC-II in the 2nd semester and vice-versa.

Assessment and Evaluation method

Chemistry Cycle:

- **MAU101D/MAU201D Shall** have the 03 hours of theory examination (SEE), however, practical sessions question shall be included in the theory question papers
- **CHU102D/CHU202D SEE** shall have the 03 hours of theory examination), however, practical sessions question shall be included in the theory question papers.
- **ESC or ETC, of 03 credits Courses** shall have only a theory component (L: T :P:S=3:0:0:0) or if the nature the of course required practical learning then the syllabus shall be designed as an Integrated course (L: T:P:S= 2:0:2:0). All **PLC** courses are Integrated courses.
- **All 01 Credit** courses shall have the SEE of 02 hours duration and the pattern of the question paper shall be MCQ
- **Integrated courses** will have 50 marks CIE and 50 Marks SEE.
- **Non-integrated courses** have 50 marks CIE (including 5 marks Assignment and 5 marks Group Activity) and 50 Marks SEE.

Physics Cycle:

- **MAU101D/MAU201D Shall** have the 03 hours of theory examination (SEE), however, practical sessions question shall be included in the theory question papers
- **PHU102D/PHU202D SEE** shall have the 03 hours of theory examination), however, practical sessions question shall be included in the theory question papers.
- **ESC or ETC, of 03 credits Courses** shall have only a theory component (L: T :P:S=3:0:0:0) or if the nature the of course required practical learning then the syllabus shall be designed as an Integrated course (L: T:P:S= 2:0:2:0). All **PLC** courses are Integrated courses.
- **All 01 Credit-** courses shall have the SEE of 02 hours duration and the pattern of the question paper shall be MCQ
- **Integrated courses** will have 50 marks CIE and 50 Marks SEE.
- **Non-integrated courses** have 50 marks CIE (including 5 marks Assignment and 5 marks Group Activity) and 50 Marks SEE.

I/II Semester

BASIC ELECTRONICS			
Course Code:	ECT103/ECT203	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1.Operation of Semiconductor diode, Zener diode and Special purpose diodes and their applications.
2. Biasing circuits for transistor (BJT) as an amplifier.
3. Study of linear Op-amps and its applications.
4. Logic circuits and their optimization.
5. Principle of basic communication system.

Module-1	**08 Hrs**

Semiconductor Diodes: Introduction, PN Junction diode, Characteristics and Parameters- Forward and Reverse Characteristics, Diode Parameters, Diode Approximations-Ideal Diodes and Practical Diodes, Piecewise Linear Characteristics, DC Equivalent Circuits. (Text 1)

Diode Applications: Introduction, Half-Wave Rectifier, Full-Wave Rectifier, Bridge Rectifier. Rectifier circuit with RC Filters. (Text 1) (Simple Numerical Examples excluding Derivations)

Zener Diodes: Zener diode Characteristics and Parameters, Equivalent Circuit, Zener Diode Voltage Regulators, Regulator Circuit with No Load, Loaded Regulator, Regulator Performance (Text 1)
(Simple Numerical Examples excluding Derivations)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Module-2	**08 Hrs**

Bipolar Junction Transistors: Introduction, BJT Operation- PNP and NPN Transistors and Operation, Bipolar Devices, BJT Voltages and Currents, Terminal Voltages, Transistor Currents.

BJT Amplification-Current Amplification, Voltage Amplification. Common Base, Common-Emitter and Common Collector Characteristics- Circuit, Input and output characteristics, Current Gain Characteristics. (Text 1)

Field Effect Transistor: Junction Field Effect Transistor - n-channel and p-channel FET, JFET Characteristics-Depletion regions, Drain Characteristics, Transfer Characteristics, MOSFETs Enhancement and Depletion MOSFETs (Text 1)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Module-3	**08 Hrs**

Signal Generators: BJT Phase Shift Oscillator, BJT Colpitts Oscillator, BJT Hartley Oscillator. (Text 1)

Operational Amplifiers: Introduction, The Operational Amplifier, Block Diagram Representation of Typical Op-Amp, Schematic Symbol. (Text 2)

Op-Amp Parameters-Gain, input resistance, Output resistance, CMRR, slew rate, Bandwidth, input offset voltage, input bias Current and Input Offset Current, The Ideal Op-Amp, Equivalent Circuit of Op-Amp, Open Loop Op-Amp configurations- Inverting Amplifiers, Non-Inverting Amplifiers, Differential Amplifiers. (Text 2)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos

RBT Level:	L1, L2

Module-4	**08 Hrs**

Boolean Algebra and Logic Circuits: Binary Systems – Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements, Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Other Logic Operations, Digital Logic Gates (Text 3)

Combinational logic: Introduction, Design procedure, Adder, Subtractor (Text 3)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Module-5	**08 Hrs**

Synchronous Sequential Logic: Introduction, Flip-flops (SR, D, JK, T): working and Truth Table, Counters (JK) and Memory Unit Introduction, Registers, Shift registers (SISO), MOD-4 Ripple Counters. (Text 3)

Communications: Introduction to communication, Block Diagram of Communication System, Modulation-Description, Need for modulation, Amplitude Modulation – Amplitude Modulation theory, Representation of AM, Frequency Modulation - Theory of Frequency and Phase Modulation. (Text 4)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Course outcomes:

At the end of the course the student will be able to:

CO1. Summarize the operation, characteristics of diodes, diode application, zener diode Characteristics and its applications.

CO2. Explain the operation of BJT and JFET with their characteristics and applications.

CO3. Interpret oscillators and operational amplifiers.

CO4. Analyze and simplify digital circuits or digital gates.

CO5. Illustrate the concepts of various sequential logic circuits and their working principles; explain the different modulation schemes.

Suggested Learning Resources:

Text Books:

1: Electronic Devices and Circuits, David A Bell, 5th Edition, Oxford, 2016.

2: Op-amps and Linear Integrated Circuits, Ramakanth A Gayakwad, Pearson Education, 2007

3: Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2017.

4: Electronic Communication Systems, George Kennedy, TMH, 1999

Reference Books (if required)

1: Mitchel E. Schultz, 'Grob's Basic Electronics', 11th Edition, McGraw-Hill, 2011.

2: Electronic Instrumentation and Measurements (3rd Edition) – David A. Bell, Oxford University Press, 2013.

Web Links: https://onlinecourses.nptel.ac.in/noc21_ee55/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**		**1**	**2**				**1**			**1**	**2**	
CO2	**3**	**2**	**3**		**2**	**1**				**1**			**1**	**2**	
CO3	**3**	**2**	**3**		**3**				**1**	**1**			**1**	**2**	
CO4	**3**	**1**	**1**		**2**	**1**			**1**	**1**		**1**	**1**	**2**	
CO5	**3**	**1**	**1**		**2**	**1**			**1**	**1**		**1**	**1**	**2**	

High-3, Medium-2, Low-1

I/II Semester

INTRODUCTION TO ELECTRONICS ENGINEERING			
Course Code:	EST104C/EST204C	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1.To prepare students with fundamental knowledge/ overview in the field of Electronics and Communication Engineering.

2. To equip students with a basic foundation in electronic engineering required for comprehending the operation and application of electronic circuits, logic design, embedded systems, and communication systems.

3. Professionalism & Learning Environment: To inculcate in first-year engineering students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Module-1	**08 hrs**
Power Supplies –Block diagram, Half-wave rectifier, Full-wave rectifiers and filters, Voltage regulators, Voltage multipliers. (Numerical on Rectifiers & Regulators) **Amplifiers** – Bipolar Junction Transistor-Current components and Voltages, Amplifying action, BJT as a switch: Cut-off and saturation modes. (Text 1)	
Teaching Learning Method: Chalk and Talk, power point presentation, animations, videos **RBT Level:** L1, L2	

Module-2	**08 hrs**
Operational amplifiers - Ideal op-amp; characteristics of ideal and practical op-amp; Practical op- amp circuits: Inverting and non-inverting amplifiers, voltage follower, summer, Subtractor, integrator, differentiator. (Text 1) Numerical **Oscillators** – Barkhausen criterion, Ladder network oscillator, Wein bridge oscillator, Crystal controlled oscillators (Only Concepts, working, and waveforms. No mathematical derivations) Numerical	
Teaching Learning Method: Chalk and Talk, power point presentation, animations, videos **RBT Level:** L1, L2	

Module-3	**08 hrs**
Binary Systems: Binary numbers, Number Base Conversion, octal & Hexa Decimal Numbers, Complements (1's, 2's, 9's and 10's complements). **Boolean Algebra and Logic Circuits:** Basic definitions, Axiomatic Definition of Boolean Algebra, Basic Theorems and Properties of Boolean Algebra, Boolean Functions, Digital Logic Gates (Text 2) **Combinational logic:** Introduction, Design procedure, Adders- Half adder, Full adder (Text 2)	
Teaching Learning Method: Chalk and Talk, power point presentation, animations, videos **RBT Level:** L1, L2	

Module-4	**08 hrs**

Embedded Systems: Definition, Embedded systems vs general computing systems, Classification of Embedded Systems, Major application areas of Embedded Systems, Elements of an Embedded System, Core of the Embedded System, Microprocessor vs Microcontroller, RISC vs CISC (Text 3)
Sensors and Interfacing: Instrumentation and control systems, Transducers, Sensors, Actuators, LED, 7-Segment LED Display. (Text 3)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Module-5	**08 hrs**

Analog Communication Schemes: Modern communication system scheme, Information source and input transducer, Transmitter, Channel or Medium – Hardwired and Soft wired, Noise, Receiver, Types of communication systems. Types of modulation (only concepts) – AM, FM, PM.
Concept of Radio wave propagation (Ground, space, sky).
Digital Modulation Schemes: Advantages of digital communication over analog communication, ASK, FSK, PSK, Multiple access techniques: TDMA, FDMA, CDMA. (Text 4)

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand the diode based and transistor-based circuits like Power supplies and Amplifiers.
CO2. Analyse and design transistor-based Oscillators and Operational amplifiers.
CO3. Apply the digital electronics knowledge to build arithmetic blocks for digital systems.
CO4. Understand the basics of microprocessor, microcontroller, RISC, CISC and Sensors based circuits.
CO5. Explain the operation and applications of modern communication systems.

Suggested Learning Resources:

Text Books:

1: Mike Tooley, 'Electronic Circuits, Fundamentals & Applications', 4th Edition, Elsevier, 2015.
2: Digital Logic and Computer Design, M. Morris Mano, PHI Learning, 2017.
3: K V Shibu, 'Introduction to Embedded Systems', 2nd Edition, McGraw Hill Education (India) Private Limited, 2016.
4: S L Kakani and Priyanka Punglia, 'Communication Systems', New Age International Publisher,2017. https://elib4u.ipublishcentral.com/pdfreader/communication-systems

Reference Books:

1: Mitchel E. Schultz, 'Grob's Basic Electronics', 11th Edition, McGraw-Hill, 2011.

Web Links: https://onlinecourses.nptel.ac.in/noc21_ee55/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		1			1	1	1		3	1	2	
CO2	3	2	2		1			1	1	1		3	1	2	
CO3	3	2	2		1			1	1	1		3	1	2	
CO4	3		1		1			1	1	1		3	1	2	
CO5	3		1		1			1	1	1		3	1	2	

High-3, Medium-2, Low-1

I/II Semester

Introduction to Internet of Things (IOT)			
Course Code:	ETT1052/ETT2052	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3: 0: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand the fundamentals of IoT and its building blocks along with their characteristics.
2. Gain knowledge of various sensors and actuators for IoT applications.
3. Understand the IoT protocols for processing and communication.
4. Gain insights about current trends of associated IoT technologies and IoT Analytics.
5. Insight into the recent application domains of IoT in everyday life.

Module-1	**08 hrs**
Basics of Networking: Introduction, Network Types, Layered network models, Addressing. **Emergence of IoT:** Introduction, Evolution of IoT, Enabling IoT and the Complex Interdependence of Technologies, IoT Networking Components, Addressing Strategies in IoT. **Textbook 1:** Chapter 1- 1.1 to 1.4 Chapter 4 – 4.1 to 4.5.	
Teaching Learning Method: Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2	
Module-2	**08 hrs**
IoT Sensing and Actuation: Introduction, Sensors, Sensor Characteristics, Sensorial Deviations, SensingTypes, Sensing Considerations, Actuators, Actuator Types, Actuator Characteristics. **Textbook 1:** Chapters 5–5.1 to 5.9.	
Teaching Learning Method: Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2, L3	
Module-3	**08 hrs**
IoT Processing Topologies and Types: Data Format, Importance of Processing in IoT, Processing Topologies, IoT Device Design and Selection Considerations, Processing Offloading. **IoT Connectivity technologies:** IEEE 802.15.4, ZigBee, RFID, NFC, LoRa, Wi-Fi, Bluetooth. **Textbook 1:** Chapter 6–6.1 to 6.5, Chapter 7–7.2,7.3,7.7, 7.8, 7.13, 7.15,7.16	
Teaching Learning Method: Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2	
Module-4	**08 hrs**
Associated IoT Technologies: Cloud Computing: Introduction, Virtualization, Cloud Models, Service-Level Agreement in Cloud Computing, Cloud Implementation, Sensor-Cloud: Sensors-as-a-Service. **Textbook 1:** Chapter 10–0.1 to 10.6.	
Teaching Learning Method: Chalk and Talk, PowerPoint Presentation **RBT Level:** L1, L2	
Module -5	**08 hrs**
IOT Case Studies and Future Trends: Vehicular IoT and IoT Analytics – Introduction. Agricultural IoT and Healthcare IoT – Introduction and Case studies. **Textbook 1:** Chapter 12-12.1-12.2, 13– 13.1, 14- 14.1-14.2, 17- 17.1.	
Teaching Learning Method: Chalk and Talk, Power Point Presentation **RBT Level:** L1, L2, L3	
Course outcomes:	

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

CO1. Describe the evolution of IoT, IoT networking components, and addressing strategies in IoT.

CO2. Classify various sensing devices and actuator types.

CO3. Illustrate the architecture of IoT applications and communication

CO4. Explain associated IoT Technologies.

CO5. Demonstrate the processing in IoT.

Suggested Learning Resources:

Text Books:

1: Sudip Misra, Anandarup Mukherjee, Arijit Roy, "Introduction to IoT", Cambridge University Press 2021.

Reference Book:

1: S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things.and Industry 4.0.CRC Press.

2: Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014.

3: Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.

Online Resources: https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-cs31/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Group activity for a group of 4 or 5 students -5 marks

Activity 2: Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											1	2	
CO2	3	2	2	2									1	2	
CO3	3	2	2										1	2	
CO4	3	2	2	2									1	2	
CO5	3	2	2	2		2	1	1	2	3			1	2	

High-3, Medium-2, Low-1

Semester: I/II

INTRODUCTION TO EMBEDDED SYSTEMS			
Course Code:	ETT1059/ETT2059	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand the basic concepts of Embedded Systems.
2. Identify a typical Embedded System building blocks and describe role of embedded firmware.
3. Familiarize the characteristics and quality attributes of Embedded Systems.
4. Introduction of Embedded System Software and Hardware development.
5. Exposure to trends of embedded industry.

Module-1	**07 hrs**

Introduction to Embedded Systems: Definition of Embedded System, Embedded Systems v/s General Computing Systems, History, Classification, Major Application areas, Purpose of Embedded Systems. Application specific embedded system: Washing machine, Domain specific: Embedded system in the automotive domain, Wearable devices: The Innovative bonding of lifestyle with embedded technologies. **TEXT 1**

Teaching Learning Method:	Chalk & white board, PowerPoint presentation
RBT Level:	L1, L2

Module-2	**10 hrs**

Typical Embedded System: Core of the Embedded System, Memory, Sensors and Actuators – Light Emi ting Diode (LED), 7-Segment LED Display, Keyboard, Communication Interface – Inter Integrated Circuit (I2C) Bus, Serial Peripheral Interface (SPI) Bus, Universal Serial Bus (USB), Infrared (IrDA), Bluetooth (BT), Wi-Fi, Embedded Firmware, Other System Components, PCB and Passive Components. **TEXT 1**

Teaching Learning Method:	Chalk & white board, PowerPoint presentation
RBT Level:	L1, L2

Module-3	**07 hrs**

Characteristics and Quality Attributes of Embedded Systems: Characteristics and Quality attributes of Embedded Systems.

Hardware Software Co-Design and Program Modelling:

Hardware Software Co-Design concept, Typical Embedded product design and development approach, Computational Models in Embedded Design. Electronic Design Automation (EDA) Tools. **TEXT 1**

Teaching Learning Method:	Chalk & white board, PowerPoint presentation
RBT Level:	L1, L2

Module-4	**07 hrs**

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages, Integration of Hardware and Firmware, The embedded system development environment, The Integrated Development Environment (IDE). **TEXT 1**

Teaching Learning Method:	Chalk & white board, PowerPoint presentation
RBT Level:	L1, L2

Module-5	07 hrs
Trends in the Embedded Industry: Processor trends in embedded system, Embedded OS trends, Development Language Trends, Open Standards, Frameworks and Alliances, Bottlenecks, Development Platform Trends, Cloud, Internet of Things (IoT) and Embedded Systems – The Next Big Thing. **Design Case Studies**: Digital camera, Smart Card Reader, Automated Meter Reading System. **TEXT 1**	
Teaching Learning Method:	Chalk & white board, PowerPoint presentation, seminars
RBT Level:	L1, L2

Course outcomes:

At the end of the course the student will be able to:

CO1. understand the basic concepts of embedded systems.

CO2. identify different elements of a typical embedded system.

CO3. acquire knowledge about characteristics, quality enhancing factors of Embedded system.

CO4. highlight different concepts of Embedded Firmware Design and Development.

CO5. analyse different trends followed in embedded industry and conduct case studies.

Suggested Learning Resources:

Text Books:

1: Shibu K V, "Introduction to Embedded Systems", First Edition, Tata McGraw Hill Education Private Limited, 2017.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1: Case studies related to embedded systems in different domains.

2: Presentation about current trends in Embedded industries.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1			1			1					1	
CO2	3	2	1			1			1					1	
CO3	3	2	1			1								1	
CO4	3	2	1			1								1	
CO5	3	2	1			1			1	1				1	

High-3, Medium-2, Low-1

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education (OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Communication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2024-25
(Applicable to 2024 batch)

III SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Department (TD) and Question Paper Setting	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	BSC	MAT301xx	Maths for AV Communication	Maths	3	2	0		03	50	50	100	4
2	IPCC	ECU302	Digital System Design using Verilog	ECE	3	0	2		03	50	50	100	4
3	IPCC	ECU303	Analog Electronic Circuits	ECE	3	0	2		03	50	50	100	4
4	PCC	ECT304	Network Analysis	ECE	3	0	0		03	50	50	100	3
5	PCCL	ECL305	Analog and Digital Electronics Laboratory	ECE	0	0	2		03	50	50	100	1
6	ESC	ECT306x	ESC/ETC/PLC	ECE	3	0	0		03	50	50	100	3
7	UHV	HST307	Social Connect and Responsibility	Any Department	0	0	2		01	100	---	100	1
8	AEC/ SEC	ECT308x or ECL308x	Ability Enhancement Course/Skill Enhancement Course – III	ECE	If the course is a Theory: 1	0	0		01	50	50	100	1
					If a course is a laboratory: 0	0	2		02				
9	HS	CDN309	Aptitude and Verbal Ability Skill-I	Placement Cell	2	0	0		--	50	--	50	PP/NP
10	MC	NSN310	National Service Scheme (NSS)	NSS coordinator	0	0	2		--	100	---	100	PP/NP
		PEN310	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		YON310	Yoga	Yoga Teacher									
									Total	550	350	900	21

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, S= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**:Semester End Evaluation. K: This letter in the course code indicates common to all the streams of Engineering. ESC: Engineering Science Course, ETC: Emerging Technology Course, PLC: Programming Language Course

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Engineering Science Course (ESC/ETC/PLC) ECT306x			
ECT306A	**Signals and system**	**ECT306C**	**Computer Organization and Architecture**
ECT306B	**Sensors and Instrumentation**	**ECT306D**	**Applied Numerical methods**
Ability Enhancement Course – III ECT308x OR ECL308x			
ECL308A	**LICs Lab using PSPICE**	**ECT308C**	**Digital Engineering Course (NASSCOM)**
ECL308B	**Simulink Programming Basics**	**ECT308D**	**IOT for Smart Infrastructure**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Communication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2024-25
(Applicable to 2024 batch)

IV SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	PCC	ECT401	Engineering Electromagnetics	ECE	3	0	0		03	50	50	100	3
2	IPCC	ECU402	Principles of Communication Systems	ECE	3	0	2		03	50	50	100	4
3	IPCC	ECU403	Modern Control systems	ECE	3	0	2		03	50	50	100	4
4	PCCL	ECL404	Communication laboratory	ECE	0	0	2		03	50	50	100	1
5	ESC	ECT405x	ESC/ETC/PLC	ECE	3	0	0		03	50	50	100	3
6	AEC/ SEC	ECT406x or ECL406x	Ability Enhancement Course/Skill Enhancement Course- IV	ECE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If the course is a lab				02				
					0	0	2						
7	BSC	BIT407	Biology For Engineers	TD / PSB: BT, CHE,	2	0	0		03	50	50	100	2
8	UHV	HST408	Universal human values course	Any Department	1	0	0		01	50	50	100	1
9	HS	CDN409	Aptitude and Verbal Ability Skill-II	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	NSN410	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	PP/ NP
		PEN410	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		YON410	Yoga	Yoga Teacher									
									Total	500	400	900	19

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study, CIE: Continuous Internal Evaluation, SEE: Semester End Evaluation. K : This letter in the course code indicates common to all the stream of engineering.

Engineering Science Course (ESC/ETC/PLC) 22ECT405x OR 22ECL405x			
ECT405A	**8051 Microcontroller**	**ECT405C**	**Operating Systems**
ECT405B	**Power Electronics**	**ECT405D**	**Engineering Statistics and Linear Algebra**
Ability Enhancement Course / Skill Enhancement Course – IV XXT405x OR XXL406x			
ECL406A	**C++ Basics**	**ECL406C**	**LabVIEW Programming**
ECL406B	**Electronic Devices**	**ECL406D**	**Risk Management in IOT Implementation**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practical of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper.

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the courses is mandatory for the award of Degree.

III Semester

<table>
<tr><th colspan="4">DIGITAL SYSTEM DESIGN USING VERILOG</th></tr>
<tr><td>Course Code:</td><td>ECU302</td><td>CIE Marks:</td><td>50</td></tr>
<tr><td>Teaching Hours/Week (L:T:P:S):</td><td>04</td><td>SEE Marks:</td><td>50</td></tr>
<tr><td>Total Hours of Pedagogy:</td><td>52</td><td>Total Marks:</td><td>100</td></tr>
<tr><td>Credits:</td><td>04</td><td>Exam Hours:</td><td>03</td></tr>
<tr><td colspan="4">Course objectives:
1. To impart the concepts of simplifying Boolean expression using K-map techniques and Quine-McCluskey minimization techniques.
2. To impart the concepts of designing and analyzing combinational logic circuits.
3. To impart design methods and analysis of sequential logic circuits.
4. To impart the concepts of Verilog HDL data flow and behavioural models for the design of digital systems.</td></tr>
<tr><td colspan="4">Module-1</td></tr>
<tr><td colspan="4">Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique. Quine-McCluskey using Don’t Care Terms.
(Section 3.1 to 3.5 of Text 1).</td></tr>
<tr><td colspan="2">Teaching Learning Method:
RBT Level:</td><td colspan="2">Chalk and Talk, YouTube videos
L1, L2, L3</td></tr>
<tr><td colspan="4">Module-2</td></tr>
<tr><td colspan="4">Logic Design with MSI Components and Programmable Logic Devices : Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs) (Section 5.1 to 5.7 of Text 2)</td></tr>
<tr><td colspan="2">Teaching Learning Method:
RBT Level:</td><td colspan="2">Chalk and Talk, YouTube videos
L1, L2, L3</td></tr>
<tr><td colspan="4">Module-3</td></tr>
<tr><td colspan="4">Flip-Flops and its Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Characteristic equations, Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T, JK, D and SR flip-flops. (Section 6.4, 6.6 to 6.9 (Excluding 6.9.3) of Text 2)</td></tr>
<tr><td colspan="2">Teaching Learning Method:
RBT Level:</td><td colspan="2">Chalk and Talk, YouTube videos
L1, L2, L3</td></tr>
<tr><td colspan="4">Module-4</td></tr>
<tr><td colspan="4">Introduction to Verilog: Typical Design Flow, Data types, Modules, Ports.
Verilog Data flow description: Continuous assignments, Delays, Expressions, Operators, and operands, operator types, Examples (Section1.3, 3.2, 6.1 to 6.5 of Text 3)</td></tr>
<tr><td colspan="2">Teaching Learning Method:
RBT Level:</td><td colspan="2">Chalk and Talk, YouTube videos, Programming assignments
L1, L2, L3</td></tr>
<tr><td colspan="4">Module-5</td></tr>
</table>

Verilog Behavioral description: Procedural Assignments, Conditional statements, Multiway branching, Loops, Examples. (Section 7.2, 7.4, 7.5, 7.6 and 7.9 of Text 3)
Verilog Structural description: Gate types, Examples. (Section 5,1 of Text 3) (Gate level description only)

Teaching Learning Method:	Chalk and Talk, YouTube videos, Programming assignments
RBT Level:	L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable simulation software, demonstrate the operation of the following circuits

Sl. No.	Experiments
1	To simplify the given Boolean expressions and realize using Verilog program.
2	To realize Adder/Subtractor (Full/half) circuits using Verilog data flow description.
3	To realize 4-bit ALU using Verilog program.
4	To realize the following Code converters using Verilog Behavioral description a) a) Gray to binary and vice versa b) Binary to excess3 and vice versa
5	To realize using Verilog Behavioral description: 8:1 mux, 8:3 encoder, Priority encoder
6	To realize using Verilog Behavioral description: 1:8 Demux, 3:8 decoder, 2-bit Comparator
7	To realize using Verilog Behavioral description: Flip-flops: a) JK type b) SR type c) T type and d) D type
8	To realize Counters - up/down (BCD and binary) using Verilog Behavioral description.

Demonstration Experiments (For CIE only – not to be included for SEE)

Use FPGA/CPLD kits for downloading Verilog codes and check the output for interfacing experiments.

9	Verilog Program to interface a Stepper motor to the FPGA/CPLD and rotate the motor in thespecified direction (by N steps).
10	Verilog programs to interface a Relay or ADC to the FPGA/CPLD and demonstrate its working.
11	Verilog programs to interface DAC to the FPGA/CPLD for Waveform generation.
12	Verilog programs to interface Switches and LEDs to the FPGA/CPLD and demonstrate its working.

Course Outcomes

At the end of the course the student will be able to:

1. Simplify Boolean functions using K-map and Quine-McCluskey minimization technique.
2. Analyze and design for combinational logic circuits.
3. Analyze the concepts of Flip Flops (SR, D, T and JK) and to design the synchronous sequential using Flip Flops.
4. Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Data flow model.
5. Model Combinational circuits (multiplexers) and sequential circuits using behavioural and structural model.

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001.
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2002.
3. HDL Programming VHDL and Verilog by Nazeih M Botros, 2009 reprint, Dream tech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Logic Design, by Sudhakar Samuel, Pearson/Sanguine, 2007
3. Fundamentals of HDL, by Cyril P R, Pearson/Sanguine2010

MOOCS:

1. Electronic Design Automation http://nptel.ac.in/courses/106105083/
2. Digital system design with PLDs and FPGA shttp://nptel.ac.in/courses/117108040/Fundamentals of HDL

Activity Based Learning (Suggested Activities in Class)/Practical Based learning

Programming Assignments/Mini Projects can be given to improve programming skills.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1											2	
CO2	3	1	1											2	
CO3	3	1	1											2	
CO4	3	1	1											2	
CO5	3	1	1											2	

High-3, Medium-2, Low-1

III Semester

ANALOG ELECTRONIC CIRCUITS			
Course Code:	ECU303	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	3

Course objectives: This course will enable students to

1. Explain various BJT parameters, connections and configurations.
2. Design and demonstrate the diode circuits and transistor amplifiers.
3. Explain various types of FET biasing and demonstrate the use of FET amplifiers.
4. Analyse Power amplifier circuits in different modes of operation.
5. Construct Feedback and Oscillator circuits using FET.

Module-1	**08 hrs**

BJT Biasing: Biasing in BJT amplifier circuits: The Classical Discrete circuit bias (Voltage-divider bias), Biasing using a collector to base feedback resistor.

Small signal operation and Models: Collector current and transconductance, Base current and input resistance, Emitter current and input resistance, voltage gain, Separating the signal and the DC quantities, The hybrid Π model.

MOSFETs: Biasing in MOS amplifier circuits: Fixing VGS, Fixing VG, Drain to Gate feedback resistor. Small signal operation and modeling: The DC bias point, signal current in drain, voltage gain, small signal equivalent circuit models, transconductance, **Text 1**

Teaching Learning Method:	Chalk and talk method, Power Point Presentation. Self-study topics: Basic BJT Amplifier Configurations- Design of Common Emitter and Common collector amplifier circuits.
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

MOSFET Amplifier configuration: Basic configurations, characterizing amplifiers, CS amplifier with and without source resistance RS, Source follower.

MOSFET internal capacitances and High frequency model: The gate capacitive effect, Junction capacitances, High frequency model. Frequency response of the CS amplifier: The three frequency bands, high frequency response, Low frequency response.

Oscillators: FET based Phase shift oscillator, LC and Crystal Oscillators (no derivation) **Text 1**

Teaching Learning Method:	Chalk and talk method, Power Point Presentation. Self-study topics: Discrete Circuit MOS Amplifier – The common source amplifier and the source follower.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Feedback Amplifier: General feedback structure, Properties of negative feedback, The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers (Qualitative Analysis).

Output Stages and Power Amplifiers: Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. **Text 1**

Teaching Learning Method:	Chalk and talk method, Power Point Presentation. Self-study topics: Class D power amplifier
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Op-Amp Circuits: Op-amp DC and AC Amplifiers, DAC – Weighted resistor and R-2R ladder, ADC-Successive approximation type, Small Signal half wave rectifier, Absolute value output circuit,
Active Filters, First and second order low-pass and high-pass Butterworth filters, Band-pass filters, Band reject filters. (no derivations only concepts) **Text 2**

Teaching Learning Method:	Chalk and talk method, Power Point Presentation. Self-study topics: Clippers and Clampers, Peak detector, Sample and hold circuit.
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

555 Timer and its applications: Monostable and Astable Multivibrators.
Thyristors: Static Anode-Cathode characteristics and Gate characteristics of SCR, Turn-On methods, Turn-off Mechanism, Turn-Off Methods: Natural and Forced Commutation – Class A without design consideration. **Text 2, 3**

Teaching Learning Method:	Chalk and talk method, Power Point Presentation. Self-study topics: Basic Construction, working and applications of DIAC, TRIAC, IGBT, GTO.
RBT Level:	L1, L2, L3

PRACTICAL COMPONENT OF IPCC

1. Design and verification of voltage follower, inverting amplifier and non- inverting amplifier using OP-AMP.
2. Design and verification of Integrator and Differentiator using OP-AMP.
3. Design and Simulation of Function generator to generate square wave and triangular wave generator using OP-AMP.
4. Analyze Input, Output characteristics of BJT Common emitter
5. Design and Simulation of input and output characteristics of MOSFET
6. Analyze of Static characteristics of SCR
7. Design and Simulation of RC Phase shift Oscillator using FET.
8. Design and Simulation of R-2R Ladder DAC.

Course Outcomes:

After the completion of the Course the student can:

CO1. Understand the characteristics of BJTs and FETs for switching and amplifier circuits.
CO2. Design and analyse FET amplifiers and oscillators with different circuit configurations and biasing conditions.
CO3. Understand the feedback topologies and approximations in the design of amplifiers and oscillators.
CO4. Design of circuits using linear ICs for wide range applications such as ADC, DAC, filters and timers.

Suggested Learning Resources:

Text Books:

1. Microelectronic Circuits, Theory and Applications, Adel S Sedra, Kenneth C Smith, 6th Edition, Oxford,2015. ISBN:978-0-19-808913-1

2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education,2018. ISBN: 978-93-325-4991-3
3. Electronic Principles, Albert Malvino, David J Bates, 7th Edition, McGraw Hill Education
4. (India)Private Limited, 2017, ISBN:978-0-07-063424-4Reference Books (if required)

Web Links:

1. www.nptel.in
2. Integrated Electronics: Analog and Digital Circuits and Systems, Jacob Millman, Christos
3. C.Halkias, McGraw-Hill, 2015.
4. Electronic Devices and Circuit, Boylestad & Nashelsky, Eleventh Edition, Pearson, January 2015.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											1	1	1
CO2	3	3	3										1	1	1
CO3	3	3	2										1	1	1
CO4	3	2	2										1	1	1

High-3, Medium-2, Low-1

III Semester

NETWORK ANALYSIS			
Course Code:	ECT304	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	2:2:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52 Hours	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03 Hrs

Course objectives:

1. To familiarize the basic laws, source transformation, source shifting and network analysis techniques.
2. To understand the network theorems and their applications for the analysis of electrical circuits.
3. To understand the transient behaviour of electrical circuits using the initial conditions.
4. To Apply Laplace transforms for the analysis of electrical circuits.
5. To evaluate the two port network parameters for the electrical circuits.

Module-1	**11 hrs**

Introduction: Ohm's Law, Nodes, Branches, and Loops, Kirchhoff's Laws, Series Resistors and Voltage division, Parallel Resistors and Current division, Wye-Delta transformations, Source Transformation, Source Shifting, Series and Parallel Capacitors, Series and Parallel Inductors.

Methods of Analysis: Nodal Analysis, Nodal Analysis with Voltage Sources, Mesh Analysis, Mesh Analysis with Current Sources, Nodal vs Mesh Analysis, Sinusoid steady-state analysis using Nodal Analysis and Mesh Analysis.

Text Book: 2.1 to 2.7, 4.4, 6.3, 6.5, 3.1 to 3.7, 10.1 to 10.3.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-2	**10 hrs**

Circuit Theorems: Linearity Property, Superposition, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer theorem.

Resonance: Series resonance and parallel resonance

Text Book: 4.2,4.3, 4.5, 4.6, 10.4, 10.6, 14.5, 14.6.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-3	**11 hrs**

Transient Behaviour and Initial Conditions: Introduction**,** the Source-Free RC circuit, the Source-Free RL circuit, Singularity Functions, Step Response of an RC circuit, Step Response of an RL Circuit, Finding Initial and Final Values.

Text Book: 7.1 to 7.6, 8.1, 8.2

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-4	**10 hrs**

Laplace Transforms: Introduction, Definition of the Laplace Transform, Properties of Laplace Transform, Circuit Element Models, and Circuit Analysis using Laplace Transforms.

Text Book: 15.1 to 15.3, 16.1 to 16.3

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-5	10 hrs
Two-Port Networks: Introduction, Impedance parameters, Admittance Parameters, Hybrid Parameters, Transmission Parameters, Relationship between Parameters, Interconnection of Networks. **Text Book: 19.1 to 19.6**	
Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Course outcomes:

At the end of the course the student will be able to:

CO1. Simplify the electrical network and analyse the electrical circuits using mesh and nodal analysis.

CO2. Solve complex electrical circuits using network theorems and explain series and parallel resonance circuits.

CO3. Evaluate the transient response of electrical circuits using initial conditions.

CO4. Apply Laplace transforms for Circuit Analysis

CO5. Evaluate the performance of two-port networks.

Suggested Learning Resources:

Text Books:

1: Fundamentals of Electric Circuits, Charles K Alexander Matthew N O Sadiku, Mc Graw Hill, 2021.

Reference Books

1: Engineering Circuit Analysis, William H Hayt et al, Mc Graw Hill, 8th Edition, 2014.

2: Network Analysis, M.E. Vanvalkenburg, Pearson, 3rd Edition, 2014.

Material:

Material will be provided by the course co-ordinator

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Quizzes

Activity 2: Seminars

Activity 3: Simulation of Electrical Circuits using PSPICE

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3											3		
CO5	2	2											3		

High-3, Medium-2, Low-1

III Semester

ANALOG AND DIGITAL ELECTRONICS LAB			
Course Code:	ECL305	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	0:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:		**Total Marks:**	100
Credits:	**01**	**Exam Hours:**	03

Course objectives:

This laboratory course enables student to:

1. Understand the electronic circuit schematic and its working
2. Realize and test amplifier and oscillator circuits for the given specifications
3. Realize the opamp circuits for the applications such as DAC, implement mathematical functions
4. and precision rectifiers.
5. Study the static characteristics of SCR and test the RC triggering circuit.
6. Design and test the combinational and sequential logic circuits for their functionalities.
7. • Use the suitable ICs based on the specifications and functions.

Sl. No.	Experiments
1	Design and set up the BJT common emitter voltage amplifier and determine the gain, bandwidth, input and output impedances.
2	Design and set-up BJT/FET i) Colpitts Oscillator ii) Crystal Oscillator
3	Design and set up the circuits using opamp: i) Adder ii) Integrator iii) Differentiator and iv) Comparator
4	Obtain the static characteristics of SCR and test SCR Controlled HWR and FWR using RC triggering circuit.
5	Design and implement (a) Half Adder & Full Adder using basic gates (b) Half subtractor & Full subtractor using basic gates (c) 4-variable function using IC74151(8:1MUX).
6	Realize (i) Binary to Gray code conversion & vice-versa using gates
7	a) Realize using NAND Gates: i) Master-Slave JK Flip-Flop, ii) D Flip-Flop and iii) T Flip-Flop
8	Realize a) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop b) Mod-N Counter using IC7490 / 7476
9	Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) for a 4-bit binary input using toggle switches (ii) by generating digital inputs using mod-16
10	Test the precision rectifiers using opamp: i) Half wave rectifier ii) Full wave rectifier
11	Design and test Monostable and Astable Multivibrator using 555 Timer

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO 1. Design and analyze the BJT/FET amplifier and oscillator circuits.

CO 2. Design and test Opamp circuits to realize the mathematical computations, DAC and precision rectifiers.

CO 3. Design and test the combinational logic circuits for the given specifications.

CO 4. Test the sequential logic circuits for the given functionality.

CO 5. Demonstrate the basic electronic circuit experiments using SCR and 555 timer.

Suggested Learning Resources:

1. Fundamentals of Electronic Devices and Circuits Lab Manual, David A Bell, 5th Edition, 2009, Oxford University Press.

2. Op-Amps and Linear Integrated Circuits, Ramakant A Gayakwad, 4th Edition, Pearson Education, 2018. ISBN: 978-93-325-4991-3.

3. Fundamentals of Logic Design, Charles H Roth Jr., Larry L Kinney, Cengage Learning, 7th Edition.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3										1	1	1
CO2	3	3	3										1	1	1
CO3	3	3	3										1	1	1
CO4	3	3	3										1	1	1
CO5	3	3	3										1	1	1

High-3, Medium-2, Low-1

III Semester

SIGNALS AND SYSTEM			
Course Code:	ECT306A	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	3

Course objectives:

1. To prepare students with fundamental knowledge/ overview of signals and systems with their properties.
2. Apply convolution to analyse how signals interact with linear time-invariant (LTI) systems and the analysis of the signals in time domain using difference/differential equations.
3. Understand the basic concepts of the Fourier series and Fourier transform for a given signal.
4. Analyse and apply the concepts of the Fourier Transform and its properties.
5. Understand the concept of the Z-transform and its significance in discrete-time signal analysis.

Module-1	**08 Hrs**
Introduction: Definition of signal and systems, classification of signals, basic operations on signals (Amplitude scaling, addition, multiplication, time scaling, time shift and time reversal), Elementary signals/Functions (Unit Step, Unit impulse, ramp, exponential, sinusoidal). **Properties of System:** Linear-nonlinear, Time variant-invariant, causal-noncausal, memory-memoryless, stable-unstable.	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2
Module-2	**08 Hrs**
Time domain representations for Linear Time Invariant Systems: Introduction, Convolution: Impulse response representation for LTI systems, Properties of the impulse response representation for LTI systems, Difference and differential equation representations for LTI systems.	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2, L3, L4
Module-3	**08 Hrs**
Fourier representations of signals: Introduction, Discrete-Time Periodic signals: The Discrete-Time Fourier Series, Continuous-Time Periodic Signals: The Fourier Series, Discrete-Time Non Periodic signals: The Discrete-Time Fourier Transform, Continuous-Time Non Periodic Signals: The Fourier Transform. (Definition and basic problems)	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2, L3, L4
Module-4	**08 Hrs**
Properties of Fourier Transform: Linearity, Symmetry, Time shift, Frequency shift, Scaling, Differentiation and Integration, Convolution and Modulation, Parsevals relationships and Duality. (Statement and Proof) **Applications of Fourier Representations:** Introduction, Frequency response of LTI system, Fourier Transform representations for periodic signals Sampling-Sampling continuous time signals.	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2, L3, L4
Module-5	**08 Hrs**

The Z-Transforms: Introduction, the Z transform, properties of the region of convergence, properties of the Z-Transform, Inverse of the Z-transform.	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	L1, L2, L3, L4

Course outcomes:

At the end of the course the student will be able to:

CO1. Demonstrate an understanding of continuous-time and discrete-time signals and perform basic operations on signals, classify systems based on their properties.

CO2. Analyse and solve time domain representations for LTI Systems and also able to classify the LTI system based on the properties.

CO3. Understand the fundamental concepts of Fourier series, Fourier transforms, and their significance in signal analysis. Apply Fourier analysis techniques to solve problems.

CO4. Demonstrate a thorough knowledge of the key properties of the Fourier Transform, including linearity, time shifting, frequency shifting, and scaling. Apply convolution and modulation theorems to solve problems involving the multiplication of signals in the time domain.

CO5. Apply the Z-transform to analyse discrete-time signals.

Suggested Learning Resources:

Text Books:

1: Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, John Wiley & Sons, Oct 2002.

Reference Books:

1: Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002.

2: Michael Roberts, "Fundamentals of Signals & Systems", 2nd edition, Tata McGraw-Hill, 2010.

3: V. Krishnaveni and A. Rajeswari, "Signals and Systems", Wiley India, Reprint 2012.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Interactive Demos and Simulations: Use interactive software or online tools to demonstrate signal transformations, system responses, and other concepts. Encourage students to manipulate parameters and observe the effects in real-time.

Activity 2: Signal Processing Workshops: Organize workshops where students work in groups to process and analyze real signals (audio, images) using software like MATLAB.

Activity 3: Case Studies: Present real-world case studies where understanding Signals and Systems is crucial. Examples include audio compression (MP3), image compression (JPEG), or equalization in audio systems.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1									2	3	1	
CO2	3	2	2									2	3	1	
CO3	3	2	2	2								2	3	1	
CO4	3	2	2	2								2	3	1	
CO5	3	2	2	2								2	3	1	

High-3, Medium-2, Low-1

III Semester

SENSORS AND INSTRUMENTATION			
Course Code:	ECT306B	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

This course will enable students to understand:

1. Operation principle, characteristics, classification of different sensors
2. types of errors in measurement and the operation of different Transducers
3. working of Multirange Ammeters, Voltmeters and Multimeters.
4. principle of operation of digital measuring instruments and Bridges.

Module-1	**08 hrs**
INTRODUCTION: introduction to sensors/transducers. principles, classification, parameters, Environmental parameters, Characterization. **MECHANICAL AND ELECTROMECHANICAL SENSORS:** Introduction, resistive potentiometer, Strain gauge, Inductive sensors, capacitive sensors, Force/stress sensors using Quartz Resonators, Ultrasonic sensors. **TEXT 1**	
Teaching Learning Method:	Chalk and talk method, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**07 hrs**
THERMAL SENSORS: Introduction, Gas thermometric sensors, Thermal expansion type thermometric sensors, Dielectric constant and refractive index thermo sensors. Nuclear thermometer, magnetic thermometer, Resistance change type thermometric sensors, thermo emf sensors, Thermal radiation sensors. **TEXT 1**	
Teaching Learning Method:	Chalk and talk method, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
MAGNETIC SENSORS: Introduction, Sensors and the principle behind, Magneto resistive sensors, Hall effect and sensors, Inductance and eddy current sensors, Angular/rotary movement transducer, Eddy current sensors, Electromagnetic flow meter, Switching magnetic sensor, SQUID sensor. **TEXT 1**	
Teaching Learning Method:	Chalk and talk method, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-4	**08 hrs**
Principles of Measurement: Static Characteristics, Error in Measurement, Types of Static Error. Voltmeters: Introduction, Multi range voltmeter. Ammeters: DC Ammeter, Multi-range Ammeter. Digital Voltmeter: Ramp Technique, Dual slope integrating Type DVM, Direct Compensation type and Successive Approximations type DVM. **TEXT 2**	
Teaching Learning Method:	Chalk and talk method, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-5	**08 hrs**
Digital Instruments: Introduction, Digital Multimeter, Digital frequency meters, Digital measurement of time. Signal Generators: Function generator, Block diagram of Oscilloscope. Bridges: Wheatstone's Bridge, Capacitance and Inductance Comparison bridge, Maxwell's bridge, Wien's bridge. **TEXT 2**	
Teaching Learning Method:	Chalk and talk method, PowerPoint Presentation
RBT Level:	L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1: Understand operation principle, classification, characteristics of sensors, mechanical and electrical sensors

CO 2: Understand operation principle, different types, characteristics of thermal sensors.

CO 3: Understand operation principle, different types, characteristics of magnetic sensors.

CO 4: Analyse principle of measurement, operation of different ammeters and voltmeters.

CO 5: Analyse the operation, classification, different types of digital instruments.

Suggested Learning Resources:

Text Books:

1. D Patranabis, "Sensors and Transducers", PHI Learning Private Limited, New Delhi – 110 001, Second Edition 2010
2. H. S. Kalsi, "Electronic Instrumentation", 3rd Edition, McGraw Hill, 2012

Reference Books:

1. David A. Bel "Electronic Instrumentation & Measurements", 2nd Edition, Oxford University Press PHI, 2006

Web Links:

http://nptel.ac.in/courses

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Seminar on different types of sensors
2. Seminar on different measuring instruments

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2							1	1					
CO2	3	2							1	1					
CO3	3	2							1	1					
CO4	3	2							1	1					
CO5	3	2							1	1					

High-3, Medium-2, Low-1

III Semester

COMPUTER ORGANIZATION AND ARCHITECTURE			
Course Code:	ECT306C	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03hrs

Course objectives:

1. Understand the meaning of basic structure of computers, and machine instructions and programs.
2. Analyze addressing modes and assembly language.
3. Compute the quantitative parameters for functions of input and output organization.
4. Associate the concepts of memory system
5. understanding the concept of simple processor organisation with two controls.

Module-1	**00 hrs**
Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation (upto 1.6.2 of Chap 1 of Text). **Machine Instructions and Programs**: Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing, (upto 2.4.6 of Chap 2 and 6.7.1 of Chap 6 of Text).	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power point presentation L1,L2,L3

Module-2	**00 hrs**
Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions (from 2.4.7 of Chap 2, except 2.9.3, 2.11 & 2.12 of text).	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power point presentation L1,L2,L3

Module-3	**00 hrs**
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, (upto 4.2.4 and 4.4 except 4.4.1 of Chap 4 of text).	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power point presentation L1,L2,L3

Module-4	**00 hrs**
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage-Magnetic Hard Disks (5.1, 5.2, 5.2.1, 5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power point presentation L1,L2,L3

Module-5	**00 hrs**
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control (upto 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power point presentation L1,L2,L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Explain the basic organization of a computer system.

CO2. Describe the addressing modes, instruction formats and program control statement.

CO3. Explain different ways of accessing an input/ output device including interrupts.

CO4. Illustrate the organization of different types of semiconductor secondary storage memories.

CO5. Illustrate simple processor organization based on hardwired control and micro programmed control.

Suggested Learning Resources:

Text Books:

1: Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw Hill, 2002.

Reference Books (if required)

1: David A. Patterson, John L. Hennessy: Computer Organization and Design – The Hardware / Software Interface ARM Edition, 4th Edition, Elsevier, 2009.

2: William Stallings: Computer Organization & Architecture, 7th Edition, PHI, 2006.

3: Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

Web Links: https://archive.nptel.ac.in/courses/106/105/106105163/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Programming Assignments / Mini Projects can be given

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2			2							1			
CO2	3	2			2							1			
CO3	3	2			2							1			
CO4	3	2		2	2							1			
CO5	3	2			3							1			

High-3, Medium-2, Low-1

LIC (Linear Integrated Circuits) Lab using PSPICE	
Course Code: **ECL308A**	CIE Marks:**50**
Teaching Hours/Week (L:T:P: S): **0:0:2:0**	SEE Marks:**50**
Credits: **1**	Exam Hours:**100**

Course objectives:

- To gain hands on experience in designing LIC applications.
- To learn simulation software used to simulate the circuits.
- To learn fundamental principles of applications of linear integrated circuits.
- To design the applications of linear integrated circuits for the given specifications.

Sl. No	Experiments using PSPICE NOTE: Every experiment has to be designed, circuit to be drawn / constructed and executed in thespecified software. Results are also to be noted and inferred.
	Note: Standard design procedure to be adopted.
1	To realize using op-amp an Inverting Amplifier and Non-Inverting Amplifier
2	To realize using op-amps i) Summing Amplifier ii)Difference amplifier
3	To realize using op-amps an Instrumentation Amplifier
4	To realize using op-amps i) Differentiator ii)Integrator
5	To realize using op-amps a Full wave Precision Rectifier
6	To realize using op-amps i) Inverting and Non-Inverting Zero Crossing Detectors ii) Positive and Negative Voltage level detectors
7	To realize using op-amp an Inverting Schmitt Trigger
8	To realize using op-amp an Astable Multivibrator
9	To design and implement using op-amps i) Butterworth I & II order Low Pass Filter ii) Butterworth I & II order High Pass Filter

10	To design and implement using op-amp a RC Phase Shift Oscillator
11	To design and implement Mono-stable Multivibrator using 555 timer
12	To design and implement 4 - bit R-2R Digital to Analog Converter

Course outcomes (Course Skill Set):

After studying this course, students will be able to;

CO1: Sketch/draw schematics of linear integrated circuit applications.

CO2: Design the applications of LIC for the given specifications.

CO3: Demonstrate the fundamentals of linear integrated circuits and their applications using PSPICE tool.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3							1	2	2			3	2	
CO2	3	3						1	2	2			3	2	
CO3	3	3			2			1	2	2			3	2	

High-3, Medium-2, Low-1

III Semester

IOT FOR SMART INFRASTRUCTURE			
Course Code:	ECT308D	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	1:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	16	**Total Marks:**	100
Credits:	01	**Exam Hours:**	02

Course objectives:

1. To provide an understanding of the concepts, principles, and applications of IoT in the context of smart infrastructure.
2. To explore the role of IoT technologies in transforming infrastructure into smart, efficient, and sustainable systems and analyse the challenges, opportunities, and considerations in implementing IoT for smart infrastructure.
3. To examine real-world case studies and successful implementations of IoT in smart cities, buildings, transportation, and energy management and explore future trends and emerging technologies shaping the field of IoT for smart infrastructure

Module-1	**04 hrs**

Introduction to IoT and Smart Infrastructure:

Introduction to IoT: Definition of IoT and its basic components, Overview of IoT applications in various industries, Importance of IoT in transforming infrastructure. Smart Infrastructure Overview: Introduction to smart infrastructure and its key components, Benefits and challenges of implementing smart infrastructure, Case studies showcasing successful smart infrastructure projects. IoT Technologies for Smart Infrastructure: Sensors and actuators: Types, functionalities, and applications; Communication protocols: Wi-Fi, Bluetooth, cellular networks, and their use in IoT; Cloud computing and data analytics in IoT for infrastructure; Edge computing: Real-time decision-making at the edge.

Security and Privacy in IoT for Smart Infrastructure: Security challenges and threats in IoT, Privacy considerations and data protection in smart infrastructure, best practices and solutions for ensuring IoT security and privacy.

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**03 hrs**

IoT Applications in Smart Cities

Introduction to Smart Cities - Definition and key features of smart cities, Role of IoT intransforming cities into smart cities, Benefits and challenges of smart city implementations.

IoT Applications in Smart City Infrastructure - Smart transportation: Intelligent traffic management and transportation systems, Smart buildings: Energy management and occupant comfort; Smart grids: Optimizing energy distribution and consumption; Waste management, water management, and environmental monitoring.

Case Studies of Smart City Implementations: Showcase of successful smart city projects around the world; Analysis of the IoT technologies and strategies implemented; Lessons le arned from these case studies.

Future Trends in Smart Cities: Emerging technologies shaping the future of smart cities, Role of IoT, AI, and 5G in advancing smart city infrastructure, Opportunities and challenges for future smart city developments.

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**03 hrs**

IoT Applications in Smart Buildings

Introduction to Smart Buildings: Definition and key features of smart buildings, Benefits of IoT in improving energy efficiency and occupant comfort, Challenges and considerations in implementing smart building technologies.

IoT Technologies for Smart Buildings: Building automation systems and controls; Energy management and monitoring using IoT devices; Indoor environmental quality monitoring and optimization; Smart lighting and HVAC systems.

Case Studies of Smart Building Implementations: Showcase of successful smart building projects; Analysis of IoT technologies and solutions deployed; Lessons learned from these case studies.

Future Trends in Smart Buildings: Emerging technologies for smart buildings; Integration of IoT with AI and machine learning; Potential impact of 5G on smart building applications.

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**03hrs**

IoT Applications in Smart Transportation

Introduction to Smart Transportation: Definition and key features of smart transportation; Role of IoT in intelligent traffic management and transportation systems; Challenges and opportunities in implementing smart transportation solutions.

IoT Technologies for Smart Transportation: Traffic sensors and monitoring systems; Intelligent transportation systems (ITS); Vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication; Real-time data analysis and predictive analytics.

Case Studies of Smart Transportation Implementations: Showcase of successful smart transportation projects; Analysis of IoT technologies and solutions deployed; Lessons learned from these case studies.

Future Trends in Smart Transportation: Emerging technologies shaping the future of smart transportation; Role of IoT, AI, and autonomous vehicles; Potential impact of 5G on smart transportation applications.

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**03hrs**

IoT for Smart Grids and Energy Management

Introduction to Smart Grids: Definition and key features of smart grids: Role of IoT in optimizing energy distribution and consumption; Benefits and challenges of smart grid implementations. IoT Technologies for Smart Grids: Smart meters and energy monitoring devices; Demand response and load management; Grid optimization and fault detection using IoT; Renewable energy integration and grid stability.

Case Studies of Smart Grid Implementations: Showcase of successful smart grid projects, Analysis of IoT technologies and solutions deployed, Lessons learned from these case studies. Future Trends in Smart Grids and Energy Management: Emerging technologies for smart grids; Integration of IoT, AI, and blockchain in energy management; Potential impact of 5G on smart grid applications.

Teaching Learning Method:	Chalk and Talk, Power point presentations

RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1: Define and explain the core concepts and components of IoT and its relevance to smart infrastructure. Identify and evaluate the key technologies and communication protocols used in IoT for smart infrastructure.

CO 2: Assess the benefits, challenges, and ethical considerations associated with implementing IoT in smart infrastructure projects and analyse & compare different IoT applications in smart cities, buildings, transportation, and energy management.

CO 3: Examine real-world case studies of successful IoT implementations in smart infrastructure and extract lessons learned. Demonstrate an understanding of security and privacy considerations in IoT for smart infrastructure.

CO 4: Discuss the impact of emerging technologies, such as artificial intelligence and 5G, on the future of IoT in smart infrastructure. Apply knowledge and critical thinking skills to propose IoT-based solutions for smart infrastructure challenges.

CO 5: Work effectively in teams to analyse, design, and present IoT projects related to smart infrastructure and communicate effectively and articulate the potential benefits and limitations of IoT for smart infrastructure.

Suggested Learning Resources:

Text Books:

1. MindMatrix.io
2. "Internet of Things (A Hands-on-Approach)" by Arshdeep Bahga and Vijay Madisetti
3. "Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry" by Maciej Kranz
4. "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia" by Anthony M. Townsend
5. "Internet of Things for Architects: Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security" by Perry Lea.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2			2								1	2	
CO2		2	3		3								1	2	
CO3	1	2	3										1	2	
CO4							1		2	3				2	
CO5				3			2	1							1

High-3, Medium-2, Low-1

IV Semester

ENGINEERING ELECTROMAGNETICS			
Course Code:	ECT401	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understanding the concepts of vectors, electric fields for EM waves and to analyze and solve problems using coulomb's law, gauss law.
2. Understanding the concepts of energy density, potential difference and capacitance.
3. Understanding the Biot Savart law, Laplace and Poisson's equations and to acquire knowledge of their practical applications.
4. Understanding the importance of Maxwell's equation and applying them for time varying fields.
5. To understand the importance of wave propagation in free space & dielectrics and applying them for time varying fields.

Module-1	**08 hrs**
Electrostatics: Coulomb's Law and electric field intensity, Field due to continuous volume charge distribution, Field of a line charge. Field of a sheet of charge. Electric flux density, Gauss' law and its applications. Divergence, Maxwell's First equation (Electrostatics), **TEXT 1**	
Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2
Module-2	**08 hrs**
Energy and potential: Energy expended in moving a point charge in an electric field, The line integral, Definition of potential difference and Potential, The potential field of a point charge, Potential gradient , Energy density in an electrostatic field. **TEXT 1**	
Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2
Module-3	**08 hrs**
Poisson's and Laplace's equations: Derivations of Poisson's and Laplace's Equations, Uniqueness theorem. **Steady magnetic field:** Biot-Savart law and its applications, Ampere's circuital law and its applications, magnetic flux and flux density **TEXT 1**	
Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2
Module-4	**08 hrs**
Magnetic forces - Force on a moving charge and differential current element, Force between differential current elements. **Maxwell's equations:** Inductance and examples, Faraday's law, Displacement current. Maxwell's equation in point and Integral form, Boundary conditions for perfect dielectric materials, magnetic boundary conditions. **TEXT 1**	
Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2,L3
Module-5	**08 hrs**
Electromagnetic waves: Wave propagation in free space and dielectrics, Propagation in good conductors – skin effect, Wave polarization, standing wave ratio. **TEXT 1**	

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2, L4

Course outcomes:

At the end of the course the student will be able to:

CO1. Able to define electrostatic field and its laws such as Coulomb's law, Gauss' law & Divergence.

CO2. Able to understand energy expanded, potential difference, Potential gradient & Energy density in electrostatic field

CO3. Able to apply and solve Ampere's circuital law and apply Maxwell's equations in wave propagation.

CO4. Able to analyze magnetic forces and Maxwell's equations.

CO5. Able to understand propagation of waves in different medium with its fundamental concepts of skin effect and standing wave ratio .

Suggested Learning Resources:

Text Books:

1. William H Hayt Jr. and John A Buck, "Engineering Electromagnetics", 8th edition, McGraw- Hill, 2012Collin RE. Foundations for microwave engineering. John Wiley & Sons; 2007.
2. David K Cheng, "Field and Wave Electromagnetics", 2nd edition, Pearson Education Asia, Indian Reprint – 2001Annapurna Das, Sisir K Das, Microwave Engineering, TMH Publication, 2001

Reference Books

1. John Krauss and Daniel A Fleisch,"Electromagnetics with Applications", 5th edition, McGraw-Hill, 1999Microwave Devices and circuits- Liao / Pearson Education. 1992
2. Edward C. Jordan and Keith G Balmain,, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Prentice – Hall of India / Pearson Education, Reprint – *2002*M.Kulkarni., "Microwave devices and Radar Engg."Umesh Publications, 2011

Web Links:

1. www.nptel.in
2.www.google.com , david k cheng fields and waves electromagnetics pdf download
3.www.google.com, william h hayt engineering electromagnetics pdf
4.www.youtube/electromagnaticsforengineers

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1: Creating physical modules

2: Exploring new technologies and presenting

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2												2	
CO2	3	3	2											2	
CO3	3	2	2											2	
CO4	3	3	2											2	
CO5	3	3	2										2	2	

High-3, Medium-2, Low-1

IV Semester

PRINCIPLES OF COMMUNICATION SYSTEMS			
Course Code:	ECU402	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S)	3: 0: 2: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

1. Understand and analyse concepts of Analog Modulation schemes viz; AM, FM., Low pass sampling and Quantization as a random process.
2. Understand and analyse concepts digitization of signals viz; sampling, quantizing and encoding.
3. Evolve the concept of SNR in the presence of channel induced noise and study Demodulation of analog modulated signals.
4. Evolve the concept of quantization noise for sampled and encoded signals and study the concepts of reconstruction from these samples at a receiver.

Module-1	**09 hrs**
Amplitude Modulation: Introduction, Amplitude Modulation: Time & Frequency Domain description, switching modulator, Envelop detector. **Double Side Band-Suppressed Carrier Modulation:** Time and Frequency Domain description, Ring modulator, Coherent detection, Costas Receiver, Quadrature Carrier Multiplexing. **SINGLE SIDE–Band and Vestigial Sideband Methods of Modulation:** SSB Modulation, VSB Modulation, Frequency Translation, Frequency Division Multiplexing.	
Teaching Learning Method:	Chalk and talk method, Power Point Presentation.
RBT Level:	L1, L2, L3

Module-2	**08 hrs**
ANGLE MODULATION: Basic definitions, Frequency Modulation: Narrow Band FM, Wide Band FM, Transmission bandwidth of FM Signals, Generation of FM Signals, Demodulation of FM Signals, FM Stereo Multiplexing, Phase– Locked Loop: Nonlinear model of PLL, Linear model of PLL. The Super Heterodyne Receiver.	
Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
NOISE: Shot Noise, Thermal noise, White Noise, Noise Equivalent Bandwidth. **NOISE IN ANALOG MODULATION:** Introduction, Receiver Model, Noise in DSB-SC receivers. Noise in AM receivers, Threshold effect, Noise in FM receivers, Capture effect, FM threshold effect, FM threshold reduction, Pre-emphasis and De-emphasis in FM.	
Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

Module-4	**07 hrs**
SAMPLING AND QUANTIZATION: Introduction, Why Digitize Analog Sources? The Low Pass Sampling Process, Pulse Amplitude Modulation. Time Division Multiplexing, Pulse-Position Modulation, Generation of PPM Waves, Detection of PPM Waves.	
Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

Module-5	07 hrs
SAMPLING AND QUANTIZATION (Contd): The Quantization Random Process, Quantization Noise, Pulse–Code Modulation: Sampling, Quantization, Encoding, Regeneration, Decoding, Filtering, Multiplexing; Delta Modulation, Application examples - (a) Video + MPEG (Text1:7.11) and (b) Vocoders (refer Section 6.8 of Reference Book 1)	
Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No.	**Experiments**
1	Generation and demodulation of Amplitude modulation (AM) wave.
2	Generation and demodulation of Double side band supressed carrier (DSB-SC) wave.
3	Generation and demodulation of Frequency modulation (FM) wave.
4	Phase locked loop Synthesis
5	Generation and demodulation of Pulse Amplitude Modulation.
6	Generation and demodulation of Pulse Position Modulation.
7	Time division multiplexing of two band limited signals.
8	Illustrate the process of sampling and reconstruction of low pass signals using Matlab.
9	Illustration of Pulse Code Modulation using Matlab
10	Illustration of Delta Modulation using Matlab.
11	Noise in AM receiver using (Matlab/ Simulink/Scilab)
12	Noise in FM receiver using (Matlab/ Simulink/Scilab)

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand the amplitude and frequency modulation techniques and analyze the perform time and frequency domain transformations.

CO2. Identify the schemes for amplitude and frequency modulation and demodulation of analog signals and compare the performance.

CO3. Characterize the influence of channel noise on analog modulated signals.

CO4. Understand the characteristics of pulse amplitude modulation, pulse position modulation and pulse code modulation systems.

CO5. Illustration of digital formatting representations used for Multiplexers, Vocoders and Video transmission.

Suggested Learning Resources:

Text Books:

1: Simon Haykins & Moher, Communication Systems, 5th Edition, John Wiley, India Pvt. Ltd, 2010, ISBN 978 – 81 – 265 – 2151 – 7.

2: Simon Haykins, An Introduction to Analog and Digital Communication, John Wiley India Pvt. Ltd., 2008, ISBN 978–81–265–3653–5.

Reference Books:

1: B P Lathi and Zhi Ding, Modern Digital and Analog Communication Systems, Oxford University Press., 4th edition, 2010, ISBN: 97801980738002.

2: H Taub & D L Schilling, Principles of Communication Systems, TMH, 2011.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars
- Micro Projects can be given to improve the skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1					1	1	1		1	3	3	
CO2	3	2	1					1	1	1		1	3	3	
CO3	3	2	1					1	1	1		1	3	3	
CO4	3	2	1					1	1	1		1	3	3	
CO5	3	2	1					1	1	1		1	3	3	

High-3, Medium-2, Low-1

IV Semester

MODERN CONTROL SYSTEMS			
Course Code:	ECU403	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	2:2:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52 Hours	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03 Hrs

Course objectives:

1.To familiarize the basic laws, source transformation, source shifting and network analysis techniques.
2. To understand the network theorems and their applications for the analysis of electrical circuits.
3. To understand the transient behaviour of electrical circuits using the initial conditions.
4. To Apply Laplace transforms for the analysis of electrical circuits.
5. To evaluate the two port network parameters for the electrical circuits.

Module-1	**08 hrs**
Introduction to Control Systems: Open loop control system, Closed loop control system, Examples of Control System. **Mathematical Modelling:** Introduction, Differential equations of Physical Systems (Only Electrical and Mechanical Systems), Transfer function of Linear Systems, Analogous Systems. **Text Book1: 1.1, 1.3, 2.1, 2.2, 2.5.**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3, L4
Module-2	**08 hrs**
Block Diagrams: Block Diagram Models, Block Diagram Reduction, Applications. **Signal Flow Graphs**: Signal-Flow Graph Models, Mason's Gain Formula, Applications. **State Variable Models:** Introduction**,** the state variables of a dynamic system, the state differential equation, signal flow graph and block diagram models, the transfer function from the state equation, the time response and the State Transition Matrix. **Text Book1: 2.6, 2.7, 3.1 to 3.4, 3.6, 3.7**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3, L4
Module-3	**08 hrs**
Transient and Steady-State Response Analysis: Introduction, First-Order Systems, Second-Order Systems, Effects of Proportional, Integral and Derivative Control Actions on System Performance, Steady-State Errors in Unity-feedback Control Systems. **Text Book2: 5.1 to 5.3, 5.7, 5.8**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3, L4
Module-4	**08 hrs**
Stability of Control Systems: Routh's Stability Criterion, Relative Stability. **Text Book2: 5.6.** **The Root-Locus Method:** Introduction, The Root Locus Concept, The Root Locus Procedure, Examples. **Text Book1: 7.1 to 7.3**	
Teaching Learning Method:	Chalk and Board, Problem Based Learning

RBT Level:	L1, L2, L3, L4	
Module-5		**08 hrs**

Frequency Response Analysis: Introduction, Correlation between Time and Frequency Response, Bode Plots, experimental determination of Transfer functions.

Text Book3: 8.1, 8.2, 8.4, 8.6

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Modern Control Systems **Integrated Laboratory Component**		**12 hrs**
Sl. No	**Experiments using PSPICE** NOTE: Every experiment has to be designed, necessary diagrams/plots to be drawn / constructed and executed in thespecified software. Results are also to be noted and inferred.	
	Note: Standard design procedure to be adopted.	
1	Obtain Cascaded, Parallel and Feedback closed loop transfer functions using MATLAB.	
2	Convert Transfer function to state space representation and Vice-versa.	
3	Obtain 2D and 3D plots of unit step response of 2^{nd} order system.	
4	Find the Time Response Specifications of unit step response of 2^{nd} order System.	
5	Draw root locus using MATLAB	
6	Draw BODE PLOTs using MATLAB	
7	Study the effect of PI controller using MATLAB	
8	Study the effect of PD controller using MATLAB	
9	Study the effect of PID controller using MATLAB	
10	Study of speed characteristics of DC motors using MATLAB.	

Course outcomes:

At the end of the course the student will be able to:.3

CO1. Obtain the mathematical model of control systems.

CO2. Simplify the control systems using graphical methods and represent the given system in state space approach.

CO3. Evaluate the system performance through time domain specifications and steady state error.

CO4. Examine stability using Routh's Criterion and Root-Locus method.

CO5. Evaluate the system performance in frequency domain.

Suggested Learning Resources:

Text Books:

1: Modern Control Systems, Richard C. Dorf and Robert H. Bishop, Pearson, 13th Edition, 2017.

2: Modern Control Engineering, Katsuhiko Ogata, Prentice Hall, 5th Edition, 2010.

3: Control Systems Engineering, I J Nagrath and M Gopal, New Age International Publishers, 4th edition, 2006.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Quizzes

Activity 2: Seminars

Activity 3: Simulation using MATLAB

Activity 4: Case studies

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3											3		
CO2	3	3											3		
CO3	3	3											3		
CO4	3	3											3		
CO5	3	3											3		

High-3, Medium-2, Low-1

IV Semester

COMMUNICATION LABORATORY			
Course Code:	ECL404	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S)	0: 0: 2: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	13	**Total Marks:**	100
Credits:	1	**Exam Hours:**	3

Course objectives:

1. Demonstrate the Analog modulation techniques.
2. Model an optical communication system and study its characteristics.
3. Simulate the digital communication concepts and compute and display various parameters along with plots/figures
4. Design, Demonstrate and Analyze filters using op-amp.

Sl. No.	Experiments
	Part –A discrete Experiments
1	Time division multiplexing and de-multiplexing using IC 8038
2	Generation and detection of standard Amplitude modulation.
3	Generation and detection of Pulse Amplitude modulation.
4	Pre-Emphasis and De-Emphasis Circuits
5	Coupling and bending loss in optical fiber communication.
6	Attenuation loss and numerical aperture in optical communication.
	Part –B Simulation using Simulink
1	Design of active second order Butterworth low pass filter.
2	Design of active second order Butterworth high pass filter.
3	Design of active second order Butterworth Band pass filter.
4	Design of active second order Butterworth Band elimination filter.
5	Pulse Width Modulation and Demodulation
6	Pulse Position Modulation and Demodulation

Course outcomes:

At the end of the course the student will be able to:

CO1: Simulate the digital modulation schemes with the display of waveforms and computation of performance parameters. ·

CO2: Design and test the analog/digital modulation circuits/systems and display the waveforms.

CO3: Design and illustrate the operation of instrumentation amplifier, LPF, HPF, DAC and oscillators using linear IC.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2					1	1	1		1	3	3	
CO2	3	3	2					1	1	1		1	3	3	
CO3	3	3	2					1	1	1		1	3	3	
CO4	3	3	2					1	1	1		1	3	3	
CO5	3	3	2					1	1	1		1	3	3	

High-3, Medium-2, Low-1

IV Semester

8051 MICROCONTROLLER			
Course Code:	ECT405A	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

This course will enable students to:

• Understand the difference between a microprocessor and a microcontroller and embedded microcontrollers.
• Familiarize the basic architecture of 8051 micro controller.
• Program 8051microprocessor using Assembly Level Language and C.
• Understand the interrupt system of 8051 and the use of interrupts.
• Understand the operation and use of inbuilt Timers/Counters and the Serial port of 8051.
• Interface 8051 to external memory and I/O devices using its I/O ports.

Module-1	**08 hrs**
8051 Microcontroller: Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing. **Text2 :** Chapter 1 section 1.1 to 1.3, chapter 3 sections 3.1 to 3.3	
Teaching Learning Method: Chalk and talk method, Power Point Presentation, **RBT Level:** L1, L2, L3	

Module-2	**08 hrs**
8051 Instruction Set: Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions. **Text2 :** Chapter 5 , chapter 6, chapter 7, chapter 8	
Teaching Learning Method: Chalk and talk method, Power Point Presentation **RBT Level:** L1, L2, L3	

Module-3	**08 hrs**
8051 Jump and Call instructions & Embedded C Jump and Call Instructions, Calls & Subroutine instructions. Assembly language program examples of subroutines and involving loops. 8051 Programming in C: Data Types and Time delay in 8051 C, I/O programming in 8051 C, Logical Operations in C. **Text2 :** chapter 8 section 8.1 to 8.4.**Text1** : chapter 7 section 7.1 to 7.3	
Teaching Learning Method: Chalk and talk method, Power Point Presentation **RBT Level:** L1, L2, L3	

Module-4	**08 hrs**
8051 Timers and Serial Port 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard, 9 pin RS232 signals, Simple Serial Port programming in Assembly and C to transmit a message and to receive data serially.	

Text1: Chapter 9 section 9.1 Chapter 10 section 10.1 to 10.5	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power Point Presentation, L1, L2, L3

Module-5	**08 hrs**

8051 Interrupts and Interfacing Applications.8051 Interrupts. 8051 Assembly language programming to generate an external interrupt using a switch, 8051 C programming to generate a square waveform on a port pin using a timer interrupt. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly and C language interfacing programming.

Text 1: Chapter 11 section 11.1 and 11.2 Chapter 13 section 13.1 to 13.2, chapter 12 section 12.1, chapter 17 section 17.2

Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power Point Presentation L1, L2, L3

Course outcomes:

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

CO1. Explain the difference between Microprocessors & Microcontrollers, Architecture of 8051 Microcontroller, Interfacing of 8051 to external memory and instruction set of 8051.

CO2. Develop 8051 Assembly level programs using the 8051-instruction set.

CO3. Develop 8051 Assembly / C language program to generate timings and waveform using 8051 timers, to send & receive serial data using 8051 serial ports.

CO4. Develop 8051 Assembly / C language programs to generate square wave on 8051 I/O port pin using interrupt and C Programme to send & receive serial data using 8051 serial port.

CO5. Interface various peripheral devices to 8051 using I/O ports.

Suggested Learning Resources:

Text Books:

1: Kenneth J. Ayala, "The 8051 Microcontroller", Kenneth J Ayala, 3rd Edition, Thomson/Cengage Learning.

2: Muhammad Ali Mazidi, Janice Gillespie Mazidi and Rollin D. McKinlay, "The 8051 Microcontroller and Embedded Systems – using assembly and C", PHI, 2006 / Pearson, 2006.

Reference Books:

1. "The 8051 Micro controller Based Embedded Systems", Manish K Patel, McGraw Hill, 2014, ISBN: 978-93-329-0125-4.

2. "Microcontrollers: Architecture, Programming, Interfacing and System Design", Raj Kamal, Pearson Education, 2005.

Web Links: https://swayam.gov.in/nd1_noc20_cs25

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1: Programming 8051 using Assembly and C programs.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3							1					2	
CO2	3	3	2		1				1					2	
CO3	3	3	2		1				1					2	
CO4	3	3	2		1				1					2	
CO5	3	3	2		1				1					2	

High-3, Medium-2, Low-1

IV Semester

POWER ELECTRONICS			
Course Code:	ECT405B	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. To get an overview of different types of power semi-conductor devices.
2. To understand the operation, characteristics of thyristors.
3. To Understand the fundamental principles of basic power electronic converters.
4. To describe the need and functions of different types of power electronics converters.

Module-1	**08 hrs**
INTRODUCTION: Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects **THYRISTORS:** Introduction, characteristics, two transistor model, turn-on and turn off methods, di/dt and dv/dt protection.	
Teaching Learning Method: Chalk and talk method, Power Point Presentation, **RBT Level:** L1, L2,L3	
Module-2	**08 hrs**
COMMUTATION TECHNIQUES: Introduction, natural commutation, forced commutation: self-commutation, impulse commutation, resonant pulse commutation and complementary commutation.	
Teaching Learning Method: Chalk and talk method, Power Point Presentation, **RBT Level:** L1,L2,L3	
Module-3	**08 hrs**
AC VOLTAGE CONTROLLERS: Introduction, principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive loads. **CONTROLLED RECTIFIERS**: Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters	
Teaching Learning Method: Chalk and talk method, Power Point Presentation, **RBT Level:** L1,L2,L3	
Module-4	**08 hrs**
DC CHOPPERS: Introduction, principle of step-down operation, step-down chopper with RL loads, Principle of step-up operation, step-up chopper with Resistive load, performance parameters, Chopper classification (Class A to Class E).	
Teaching Learning Method: Chalk and talk method, Power Point Presentation, **RBT Level:** L1,L2,L3	
Module-5	**08 hrs**
INVERTERS: Introduction, principle of operation, performance parameters, single phase bridge inverters, Three phase inverters, voltage control of single phase inverters, current source inverter, principles of switched mode power supply (SMPS).	

Teaching Learning Method:	Chalk and talk method, Power Point Presentation,
RBT Level:	L1,L2,L3

Course outcomes:

At the end of the course the student will be able to:

CO1. To give an overview of applications power electronics, different types of power semiconductor devices, explain the construction, working and characteristics of SCR

CO2. To analyse different commutation techniques of SCR

CO3. To explain the analysis techniques, performance parameters and characteristics of controlled rectifiers and Voltage controllers

CO4. To explain the analysis techniques, performance parameters and characteristics of DC-to-DC converters

CO5. To explain the analysis techniques, performance parameters and characteristics of DC to AC converters

Suggested Learning Resources:

Text Books:

1: Ned Mohan, Tore M. Undeland, William P Robbins, "Power Electronics: Converters, Applications, and Design", John Wiley and Sons Inc.,, New York, 2003.

2: Rashid M.H., "Power Electronics Circuits, Devices and Applications ", Prentice Hall , India, New Delhi, 2004.

3: Joseph Vithayathil, e, "Power Electronics, Principles and Applications", Tata McGraw-Hill Edition, 2010.

Reference Books:

1: Singh M.D., Khanchandani K B, "Power Electronics", Tata McGraw Hill, 2nd Edition, New Delhi, 2007.

2: Dr.P.S.Bimbra., "Power Electronics", Khanna Publications, 3rd Edition, 2003.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1:

Activity 2:

Activity 3:

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	3	
CO2	3	3											2	3	
CO3	3	3											2	3	
CO4	3	3											2	3	
CO5	3	3											2	3	

High-3, Medium-2, Low-1

IV Semester

OPERATING SYSTEMS			
Course Code:	ECT405C	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3: 0: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

This course will enable students to understand:

1. the history and types of operating systems.
2. the design issues associated with operating systems development.
3. the process management and scheduling of operating system.
4. the concepts of memory management of operating system.
5. the file and I/O operations of operating system.

Module 1	**07 hrs**

INTRODUCTION: Goals of an O.S, Operation of an O.S

OVERVIEW OF OPERATING SYSTEMS: OS and computer system, Efficiency, system performance and user convenience, Classes of operating systems, O.S and the computer system, Batch processing system, Multi programming systems, Time sharing systems, Real time operating systems. **TEXT 1**

Teaching Learning Method:	Chalk and Board, PowerPoint Presentation
RBT Level:	L1, L2

Module 2	**08 hrs**

STRUCTURE OF THE OPERATING SYSTEMS: Operation of an O.S, Structure of an operating system, Operating systems with monolithic structure, Layered design of an operating system, Virtual machine operating systems, Kernel based operating systems. **TEXT1**

Teaching Learning Method:	Chalk and Board, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module 3	**08 hrs**

PROCESS MANAGEMENT: Process and programs, Programmer view of processes, OS view of processes, Threads.

SHEDULING: Preliminaries, Non pre-emptive scheduling policies, pre-emptive scheduling policies, scheduling in practice. **TEXT 1**

Teaching Learning Method:	Chalk and Board, Power Point Presentation
RBT Level:	L1, L2, L3

Module 4	**08 hrs**

MEMORY MANAGEMENT: Managing the memory hierarchy, static and dynamic memory allocations, memory allocation to a process, reuse of memory, contiguous and non contiguous memory allocation, paging, segmentation, segmentation with paging.

VIRTUAL MEMORY: Virtual memory Basics, Demand paging, page replacement policies. **TEXT 1**

Teaching Learning Method: **RBT Level:**	Chalk and Board, PowerPoint Presentation L1, L2

Module 5	**08 hrs**

FILE SYSTEMS: File system and IOCS, Files and file organization, Fundamentals of file organizations, Directory structures, File protection, Interface between file system and IOCS, Allocation of disk space. implementation of file access. **TEXT 1**

Teaching Learning Method: **RBT Level:**	Chalk and Board, Power Point Presentation L1, L2

Course outcomes

CO1: Understand the evolution of operating systems and various types of operating systems in practice

CO2: Analyse the structure of operating system.

CO3: Analyse the concepts of process management and different scheduling management.

CO4: Understand the design issues in memory management and virtual memory.

CO5: Understand the file and I/O management techniques.

Suggested Learning Resources:

Text Book:

1. D. M. Dhamdhare, "Operating Systems", Second Edition, TMH, 2008

Reference Books:

1. Stalling William, "Operating Systems", Sixth edition, Pearson Education,
2. Avi Silberchatz, Peter Baer Galvin, Greg Gagne, "Operating system Concepts", Ninth edition, John wiley & Sons

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Seminar on different types of Operating System.
2. Problems on Scheduling Policies.
3. Posters about Fundamental Functions of Operating System.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		2								1			
CO2		2	2	2						2		2			
CO3	2	2	2			1	1					1			
CO4	2	2		2							1	1			
CO5	2	2									1	1			

High-3, Medium-2, Low-1

IV Semester

C++ Basics			
Course Code	ECL406A	**CIE Marks**	50
Teaching Hours/Week (L: T:P: S)	0:0:2:0	**SEE Marks**	50
Credits	01	**Exam Hours**	03

Course objectives:

1. Understand object-oriented programming concepts, and apply them in solving problems.
2. To create, debug and run simple C++ programs.
3. Introduce the concepts of functions, friend functions, inheritance, polymorphism and function overloading.
4. Introduce the concepts of exception handling and multithreading.

Sl. No	Experiments
1	Write a C++ program to find largest, smallest & second largest of three numbers using inline functions MAX & Min.
2	Write a C++ program to calculate the volume of different geometric shapes like cube, cylinder and sphere using function overloading concept.
3	Define a STUDENT class with USN, Name & Marks in 3 tests of a subject. Declare an array of 10 STUDENT objects. Using appropriate functions, find the average of the two better marks for each student. Print the USN, Name & the average marks of all the students.
4	Write a C++ program to create class called MATRIX using two-dimensional array of integers, by overloading the operator == which checks the compatibility of two matrices to be added and subtracted. Perform the addition and subtraction by overloading + and – operators respectively. Display the results by overloading the operator <<. If (m1 == m2) then m3 = m1 + m2 and m4 = m1 – m2 else display error
5	Demonstrate simple inheritance concept by creating a base class FATHER with data members: *First Name, Surname, DOB & bank Balance* and creating a derived class SON, which inherits: Surname & Bank Balance feature from base class but provides its own feature: First Name & DOB. Create & initialize F1 & S1 objects with appropriate constructors & display the FATHER & SON details.
6	Write a C++ program to define class name FATHER & SON that holds the income respectively. Calculate & display total income of a family using Friend function.
7	Write a C++ program to accept the student detail such as name & 3 different marks by get_data()method & display the name & average of marks using display() method. Define a friend function for calculating the average marks using the method mark_avg().
8	Write a C++ program to explain virtual function (Polymorphism) by creating a base class polygon which has virtual function areas two classes rectangle & triangle derived from polygon & theyhave area to calculate & return the area of rectangle & triangle respectively.
9	Design, develop and execute a program in C++ based on the following requirements: An EMPLOYEE class containing data members & members functions: i) Data members: employee number (an integer), Employee_ Name (a string of characters), Basic_ Salary (in integer), All_ Allowances (an integer), Net_Salary (an integer). (ii) Member functions: To read the data of an employee, to calculate Net_Salary & to print the values of all the data members. (All_Allowances = 123% of Basic, Income Tax (IT) =30% of gross salary (=basic_ Salary_All_Allowances_IT).
10	Write a C++ program with different class related through multiple inheritance & demonstrate theuse of different access specified by means of members variables & members functions.

11	Write a C++ program to create three objects for a class named count object with data members such as roll_no & Name. Create a members function set_data ( ) for setting the data values & display ( ) member function to display which object has invoked it using „this" pointer.
12	Write a C++ program to implement exception handling with minimum 5 exceptions classes including two built in exceptions.

Suggested Learning Resources:

1. Object oriented programming in TURBO C++, Robert Lafore, Galgotia Publications, 2002
2. The Complete Reference C++, Herbert Schildt, 4th Edition, Tata McGraw Hill, 2003.
3. Object Oriented Programming with C++, E Balaguruswamy, 4th Edition, Tata McGraw Hill, 2006.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**							**1**	**1**					
CO2	**3**	**2**							**1**	**1**					
CO3	**3**	**2**							**1**	**1**					
CO4	**3**	**2**							**1**	**1**					
CO5	**3**	**2**							**1**	**1**					

High-3, Medium-2, Low-1

Dr. Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Communication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2024-25
(Applicable to 2023 batch)

V SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD)and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	HSMS	22ECT501	Technological Innovation Management and Entrepreneurship	ECE	3	0	0		03	50	50	100	3
2	IPCC	22ECU502	ARM Microcontroller	ECE	3		2		03	50	50	100	4
3	PCC	22ECT503	Digital Signal Processing	ECE	3	0	0		03	50	50	100	4
4	PCCL	22ECL504	Digital Signal Processing Laboratory	ECE	0	0	2		03	50	50	100	1
5	PEC	22ECT505x	Professional Elective Course	ECE	3	0	0		03	50	50	100	3
6	PROJ	22ECM506	Mini Project	ECE	0	0	4		03	100		100	2
7	AEC	22RMT507	Research Methodology and IPR	EEE department	2	2	0		02	50	50	100	3
8	MC	22CVT508	Environmental Studies	TD: CV PSB: CV	2	0	0		02	50	50	100	2
9	HS	22CDN509	Aptitude and Verbal Ability Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP
10	MC	22NSN510	National Service Scheme (NSS)	NSS coordinator	0	0	2			100		100	PP/ NP
		22PEN510	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON510	Yoga	Yoga Teacher									
									Total	500	300	800	22

PCC: Professional Core Course, PCCL: Professional Core Course laboratory, UHV: Universal Human Value Course, MC: Mandatory Course (Non-credit), AEC: Ability Enhancement Course, SEC: Skill Enhancement Course, L: Lecture, T: Tutorial, P: Practical, S= Self-Study CIE: Continuous Internal Evaluation, SEE:Semester End Evaluation. K : The letter in the course code indicates common to al the stream of Engineering. PROJ: Project /Mini Project. PEC: Professional Elective Course

Professional Elective Course 22ECT505x			
22ECT505A	**System Verilog for verification**	**22ECT505D**	**Multicore Architecture**
22ECT505B	**Artificial Intelligence**	**22ECT505E**	**Advanced Control Systems**
22ECT505C	**Fundamentals of Virtual Reality**	**22ECT505F**	**Programming with Python**

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Mini-project work: Mini Project is a laboratory-oriented/hands on course that will provide a platform to students to enhance their practical knowledge and skills by the development of small systems/applications etc. Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or amultidisciplinary Mini- project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two faculty members of the Department, one of them being the Guide. The CIE marks awarded for the Mini-project work shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio of 50:25:25. The marks awarded for the project report shall be the same for all the batches mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all the guides of the project.

The CIE marks awarded for the Mini-project, shall be based on the evaluation of the project report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

No SEE component for Mini-Project.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering a professional elective is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Dr.Ambedkar Institute of Technology, Bengaluru-560056
Outcome Based Education(OBE) and Choice Based Credit System
B.E. Name of the programme: Electronics and Communication Engineering
Tentative Scheme of Teaching and Examination effective from the Academic Year 2024-25
(Applicable to 2023 batch)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self - Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22ECU601	Microwave and Antenna	ECE	3	0	2		03	50	50	100	4
2	PCC	22ECT602	CMOS VLSI Design	ECE	3	2	0		03	50	50	100	4
3	PEC	22ECT603x	Professional Elective Course	ECE	3	0	0		03	50	50	100	3
4	OEC	22ECT604x	Open Elective Course	ECE	3	0	0		03	50	50	100	3
5	PROJ	22ECP605	Major Project Phase I	ECE	0	0	4		03	100	--	100	2
6	PCCL	22ECL606	VLSI Laboratory	ECE	0	0	2		03	50	50	100	1
7	AEC/SDC	22XXT607x OR 22XXL607x	Ability Enhancement Course/Skill Development Course V	ECE	If the course is offered as a Theory				01	50	50	100	1
					1	0	0						
					If course is offered as a practical								
					0	0	2						
8	HS	22CDN608	Analytical and Reasoning Skills	Placement Cell	2	0	0		--	50	--	50	PP/ NP
9	MC	22NSN609	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	PP/ NP
		22PEN609	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		22YON609	Yoga	Yoga Teacher									
									Total	500	300	800	18

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical, **S**= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to all the stream of Engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course.

Professional Elective Course 22ECT603x			
22ECT603A	**Satellite Communication**	**22ECT603D**	**Digital Image Processing**
22ECT603B	**Cryptography**	**22ECT603E**	**Robotics and Machine Vision System**
22ECT603C	**Machine Learning**	**22ECT603F**	**Adaptive Signal Processing**
Open Elective Course 22ECT604x			
22ECT604A	**Mechatronics**	**22ECT604C**	**RTOS**
22ECT604B	**MEMS**	**22ECT604D**	**Robotics Mechanics and Control**

Ability Enhancement Course / Skill Enhancement Course-V 22ECT607x OR 22ECL607x			
22ECT607A	**Automotive Electronics**	**22ECT607C**	**Real Time Embedded Systems**
22ECT607B	**Introduction to E-Vehicles**	**22ECT607D**	**Introduction to Unmanned Aerial Vehicle (UAV)**

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National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first Week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the Degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of Degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they canopt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under theguidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

V Semester

TECHNOLOGICAL INNOVATION MANAGEMENT AND ENTREPRENEURSHIP			
Course Code:	22ECT501	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	4:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

1. Understand basic skills of Management.
2. Understand the need for Entrepreneurs and their skills.
3. Identify the Management functions and Social responsibilities.
4. Understand the Ideation Process, creation of Business Model.

Module-1	**08 hrs**

Management: Nature and Functions of Management- Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession
(Selected topics of Chapter 1, Text 1).
Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making-Meaning, Types and Steps in Decision Making
(Selected topics from Chapters 4 & S, Text 1). L1,L2

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2

Module-2	**07 hrs**

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees-Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; Staff"mg-Need and Importance, Recruitment and Selection Process
(Selected topics from Chapters 7, 8 & 11, Text 1).
Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication - Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership.
(Selected topics from Chapters 15to 18and 9, Text 1).

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2

Module-3	**08 hrs**

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance
(Selected topics from Chapter 3, Text 1).
Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship
(Selected topics from Chapter 2, Text 2).

Teaching Learning Method: **RBT Level:**	Chalk and Talk, PowerPoint Presentation L1, L2

Module-4	**08 hrs**

Family Business: Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses
(Selected topics from Chapter 4, (Page 71-75) Text 2).
Idea Generation and Feasibility Analysis- Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility.
(Selected topics from Chapter 6(Page No. 111-117) & Chapter 7(Page No. 140-142), Text 2)

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations L1, L2

Module-5	**08 hrs**

Business model- Meaning, designing, analyzing and improvising; Business Plan - Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails?
(Selected topics from Chapter 8 (Page No 159-164, Text 2)

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations **RBT Level:** L1, L2

Course outcomes:

At the end of the course the student will be able to:

CO 1. Understand the fundamental concepts of Management and Entrepre- neurship and opportunities in order to setup a business

CO 2. Identify the various organizations' architecture

CO 3. Describe the functions of Managers, Entrepreneurs and their social responsibilities

CO 4. Understand the components in developing a business plan

CO 5. Recognize the various sources of funding and institutions supporting entrepreneurs.

Suggested Learning Resources:

Text Books:

1. Principles of Management - P.C Tripathi, P.N Reddy, McGraw Hill Education, fYhEdition, 2017. ISBN-13:978-93-5260-5354.

2. Entrepreneurship Development Small Business Enterprises- Poomima MCharantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.

3. Dynamics ofEntrepreneurial Development and Management byVasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.

4. Robert D. Hisrich, Mathew J. Manimala, Michael PPeters and DeanA. Shepherd, "Entrepreneurship", S1h Edition, Tata Mc-Graw HillPublishing Co.Ltd.- New Delhi, 2012

Reference Books:

1. Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, I01h Edition 2016. ISBN- 978-93-392-2286-4.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

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CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

High-3, Medium-2, Low-1

VI Semester

ARM Microcontrollers			
Course Code:	22ECU502	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

1. to describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.
2. to Program ARM Cortex M3 for different applications.
3. to analyse the Thumb instruction set and different C-Programming concepts.
4. to describe Cortex M Architecture
5. to program ARM Cortex M3/M4 MCUs:

6. **Module-1**	**07 hrs**

ARM Embedded System: RISC Design Philosophy, ARM design Philosophy, Embedded System hardware and Embedded System software.

ARM Processor Fundamentals: Registers, Current Program Status Registers, Pipeline, Exceptions, Interrupts and the Vector table, Core Extensions, Architecture Revisions, ARM processor families.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**07 hrs**

Introduction to the ARM Instruction set: Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**07 hrs**

Introduction to the THUMB instruction set: Introduction, THUMB register usage, ARM – THUMB interworking, other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.

Efficient C Programming: Overview of C Compilers and optimization, Basic C Data types, C looping structures.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Cortex M Architecture: Advantages of Cortex M CPUs, Programmer's model: Operation modes & states, Registers, Special Registers, APSR, Memory System, Low power modes, Instruction Set: Memory access instructions, Arithmetic, Logical, Shift, Program flow control instructions, Programming examples, IDEs.

Text 2

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	10 hrs
ARM Cortex M3/M4 MCUs: Architecture, Memory organization, GPIO, Programming: Assembly level, Interfacing LEDs, Relay and Push buttons, Analog to digital converters (ADC), Digital to Analog Converter (DAC), Interfacing LCD, Interfacing keyboard, Programming UART, PWM, DC and stepper motor control, RTC interfacing. **Text 3**	
Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations **RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Conduct the following experiments by writing Assembly Language Program (ALP) using ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool

Sl. No.	Experiments	12 hrs
1.	Write an ALP to find the sum of first 10 integer numbers.	
2.	Write an ALP to calculate the value of the polynomial function.	
3.	Write an ALP to store data in desired Memory location.	
4.	Write a C program to Output the message using UART of LPC1768.	
5.	Write a C Program to interface LED using LPC 1768.	
6.	Write a C Program to interface Relay using LPC 1768.	
7.	Write a C Program for DC motor/Stepper motor rotation using LPC 1768.	
8.	Write a C Program to interface a DAC and generate Triangular and Square waveforms.	
9.	Write a C program to demonstrate the use of an External interrupt in LPC 1768	

Demonstration Experiments (For CIE only not for SEE)

Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' & Keil µvision-4 tool/compiler.

10.	Write a C program to interface a Real Time Clock (RTC) of LPC 1768.
11.	Write a program to read on-chip ADC value and display it on UART terminal using LPC 1768
12.	Write a C program to interface Keypad using LPC 1768.

Course outcomes:

At the end of the course the student will be able to:

CO 1: Describe the architectural features and instructions of 32-bit microcontroller ARM Cortex M3.

CO 2: Apply the instruction set to Program ARM Cortex M3 for different applications.

CO 3: Analyse Thumb Instruction set and C-Programming Concepts to Program ARM Cortex M3.

CO 4: Analyse advantages, instructions set of Cortex M Architecture.

CO 5: Program ARM Cortex M3/M4 MCUs for interfacing different sensors and actuators

Suggested Learning Resources:

Text Books:

1. Andrew N Sloss, “ARM System Developer’s guide”, Elsevier Publications, 2016.
2. Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3 and Cortex-M4 Processors”, Newnes, Elsevier.
3. STM32 Arm Programming for Embedded Systems, Shujen Chen, Eshragh Ghaemi, Muhammad Ali Mazidi, Microdigitaled, ISBN: 978-0997925944.

Reference Books:

1. Reference manuals: STM32F411, LPC1768.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2												3	
CO2	3	2												3	
CO3	3	2												3	
CO4	3	2	2		2		1		1					3	
CO5	3	2	2		2		1		1					3	

High-3, Medium-2, Low-1

V Semester

DIGITAL SIGNAL PROCESSING			
Course Code:	22ECT503	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	4:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

1. To learn and understand Discrete Fourier Transforms, Fast Fourier Transforms, IIR filters , FIR filters and their structures
2. To apply the concept of sampling theorem, DFT, FFT algorithms, IIR and FIR filters
3. To illustrate the DFT, FFT algorithms, IIR and FIR filters
4. To design the analog IIR, digital IIR and FIR filters
5. To interpret the introduction to machine learning and classification

Module-1	**08 hrs**
Discrete Fourier Transform (DFT) and its Properties: Frequency domain sampling and reconstruction of discrete time signals: DFT and IDFT, Numerical examples. Properties of DFT: Periodicity, linearity, Symmetry properties, Circular folding, Circular Convolution, Circular time shift, Circular frequency shift, Complex conjugate property, Multiplication of two sequences, Use of DFT in linear filtering, overlap-save and overlap-add method. **TEXT 1 and TEXT 2**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-2	**07 hrs**
Fast-Fourier-Transform (FFT) Algorithms: Direct computation of DFT, need for efficient computation of the DFT (FFT algorithms). Radix-2 FFT algorithm for the computation of DFT and IDFT: Decimation-in-time (DIT) and Decimation-in-frequency (DIF) algorithms. **TEXT 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-3	**07 hrs**
IIR Filter Design: Characteristics of commonly used analog filters – Butterworth and Chebyshev filters, analog to analog frequency transformation. **Design of IIR Digital filters from analog filters (Butterworth and Chebyshev Type):** Impulse Invariance method and Bilinear transformation method, Derivation and design problems. **TEXT 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3
Module-4	**07 hrs**
FIR Filter Design: Introduction to FIR filters, Design of FIR filters using Rectangular, Hamming and Hanning windows. **TEXT 1 and TEXT 2**	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3
Module-5	**10 hrs**

Implementation of Discrete-Time Systems: Structures for IIR systems: Direct form I & II, Cascade & Parallel form realization. Structures for FIR systems: Direct form, Linear phase, Cascade form.
Introduction to Multirate Digital Signal Processing: Introduction, Decimation by factor D, Interpolation by factor I
TEXT 1 and TEXT 2

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Define Discrete Fourier Transforms and their properties.
CO 2 - Analyse the digital signals using various digital transforms DFT, FFT
CO 3 - Apply design steps in Butterworth and Chebyshev Filter design
CO 4 - Apply different windowing techniques and analyze their performance
CO 5 - Theory behind machine learning and its classification

Suggested Learning Resources:

Text Books:

1. **Proakis & Monalakis,** "Digital Signal Processing-Principles, Algorithms & Applications", Fourth Edition, Pearson Education, New Delhi, 2009
2. **Emmanuel C Ifeachor and Barrie W Jervis,** "Digital Signal Processing: A Practical Approach", Second edition, Pearson Education, New Delhi, 2002

Reference Books:

1. Alan V. Oppenheim and Schaffer, "Discrete Time Signal Processing", 2nd edition, PHI, 2007
2. Sanjit K. Mitra, "Digital Signal Processing", 3rd edition, Tata Mc-Graw Hill, 2010
3. Lee Tan, "Digital Signal Processing", edition, Elsevier publications, 2007
4. Shenoy, "Introduction to Digital Signal Processing and Filter Design", 1st edition, John Wiley & Sons, 2010
5. Lonnie C. Ludeman, "Fundamentals of Digital Signal Processing", International edition, John Wiley & Sons, 1988

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	2								2	2	
CO2	3	2	3	1	2								2	2	
CO3	3	3	3	1	2								2	2	
CO4	3	2	3	1	2								2	2	
CO5	3	2	2	1	2								2	2	

High-3, Medium-2, Low-1

V Semester

DIGITAL SIGNAL PROCESSING LAB			
Course Code	22ECL504	**CIE Marks**	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	**SEE Marks**	50
Credits	01	**Exam Hours**	03

Course objectives:

This laboratory course enables students to

1. To analyze the sampling process, impulse response, convolution, frequency domain response of LTI systems
2. To analyze and design of digital IIR and FIR filters
3. To demonstrate the DSP algorithms using Matlab software
4. To demonstrate the DSP algorithms using Code Composer Studio and DSP kit TMS320C6748

Sl. No.	Experiments
1	Impulse response of a given system
2	Linear convolution of two given sequences.
3	Circular convolution of two given sequences
4	Linear convolution of two sequences using DFT and IDFT.
5	Circular convolution of two given sequences using DFT and IDFT
6	Design and implementation of FIR filter to meet given specifications.
7	Design and implementation of IIR Butterworth filter to meet given specifications.
8	Design and implementation of IIR Chebyshev filter to meet given specifications
	Hardware programs using TMS320C6748 DSK
9	Linear convolution of two given sequences.
10	Circular convolution of two given sequences.
11	Computation of N- Point DFT of a given sequence
12	Impulse response of first order system.

Course outcomes (Course Skill Set):

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

CO1 Define and verify the sampling theorem, impulse response, convolution and frequency response of the system

CO2 Understand basic algorithms of DSP

CO3 Design an IIR and FIR digital filter

CO4 Implementation of DSP algorithms using Matlab software and using Code Composer Studio (CCS) on DSP processor

CO5 Conduction of DSP experiments on virtual laboratory

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	3	2									2	2	
CO2	3	2	3	2									2	2	
CO3	3	2	3	2									2	2	
CO4	3	2	3	2									2	2	
CO5	3	2	3	2									2	2	

` **High-3, Medium-2, Low-1**

V Semester

SYSTEM VERILOG FOR VERIFICATION			
Course Code:	22ECT505A	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Insight to apply System Verilog concepts to do synthesis, analysis and architecture design.
2. Understanding of System Verilog and SVA for verification, and understand the improvements in verification efficiency.
3. Analyze coverage driven verification for given design under test (DUT).
4. Understand advanced verification features, such as the practical use of classes, randomization, checking, and coverage.
5. Knowledge to communicate the purpose and results of a design experiment in written and oral presentations.

Module-1	**08 hrs**

Verification Guidelines: Introduction, Verification Process, Verification Plan, Verification Methodology Manual, Basic Test bench Functionality, Directed Testing, Methodology Basics, Constrained-Random Stimulus, Functional Coverage.
Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Data Types: Built-in Data Types, Fixed-Size Arrays, Dynamic Arrays, Queues, Creating New Types with typedef, Creating User-Defined Structures, Enumerated Types, Constants, Strings.
Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Basic Object-Oriented Programming: Where to Define a Class, OOP Terminology, Understanding Dynamic Objects.
System Verilog Assertions: Types of Assertions and examples.
Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Threads and Inter-process Communication: Working with Threads, Inter-process Communication, Events, Semaphores, Mailboxes, Building a Test bench with Threads and IPC Functional Coverage: Coverage Types, Functional Coverage Strategies, Simple Functional Coverage Example, Coverage Options, Parameterized Cover Groups.
Text 1 and Text 2

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Powerpoint presentations L1, L2, L3

Module-5	**08 hrs**

Introduction to formal verification: Introduction to formal techniques and property specification, Reachability analysis, Elements of property languages, Property language layers, PSL basics, Formal test plan process.

Text 2 and Text 3

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Powerpoint presentations **RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Use System Verilog to create correct, efficient, and reusable models for digital designs.
CO2. Use System Verilog to create test benches for digital designs.
CO3. Understand and effectively exploit new constructs in System Verilog for verification.
CO4. Use of threads and inter-process communication for system Verilog.
CO5. Understand the process of formal verification.

Text Book:

1. Chris Spear, "**System Verilog for Verification: A Guide to Learning the Test bench Language Features"**, Springer 2006.

2. Janick Bergeron, **"Writing Test benches Using System Verilog**", Springer, 2006.

3.Stuart Sutherland, Simon Davidman and Peter Flake, **"System Verilog for Design: A Guide to Using System Verilog for Hardware Design and Modeling**", 2nd Edition, Springer.

Reference Books:

1.Janick Bergeron, **"Writing Test benches: Functional Verification of HDL Models**", Second edition, Kluwer Academic Publishers, 2003.

Co-po Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	2	1											
CO2		2	2	1	1										
CO3		2	2	2	1										
CO4		3	2	2											
CO5		2	2	1											

High-3, Medium-2, Low-1

V Semester

ARTIFICIAL INTELLIGENCE			
Course Code:	22ECT505B	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Identify the problems where AI is required and the different methods available
2. Compare and contrast different AI techniques available.
3. Define and explain learning algorithms

Module-1	**08 hrs**

Introduction to Artificial Intelligence, AI Problems, AI Techniques, Tic-Tac-Toe, Question Answering, The level of the Model, Problems, Problem Spaces And Search: Defining The Problem As A State Space Search, Control Strategies, Heuristic Search, Problem Characteristics, Issues In The Design Search Programs.

Text Book1: Ch 1,2

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Knowledge Representation Issues:Representation and Mappings, Approaches to Knowledge Representation, Issues in Knowledge Representation, Relationships among Attributes, Finding the Right Structures as Needed.

Representing Simple Facts In Logic, Representating Instance and ISA Relationships, Computable Functions and Predicates, Natural Deduction.

Procedural versus Declarative Knowledge,Logic Programming, Forward Versus Backward Reasoning.

Text Book1: Ch 4,5,6

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Symbolic Reasoning Under Uncertainity : Introduction to Non- Monotonic Reasoning, Default Reasoning, Minimalist Reasoning, Implementation Issues.

Statistical Reasoning: Probability and Bayers Theorem, Certainity Factors and Rule- Based Systems, Bayesian Networks, Dempster-Shafer Theory.

Text Book1: Ch 7,8

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Game Playing: Overview, The MINMAX search procedure, Adding Alpha-Beta cutoffs, Iterative deepening

Introduction and steps in process, syntactic processing, Grammers and parsers, ATN, SNLP, Corpora

Text Book1: Ch12 & 15

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

Introduction to learning, Learning in problem solving, Learning from examples: Induction, Winston's Learning program, Version Spaces, Discovery, BACON: Data -Driven Discovery, Neural Net learning and Genetic leraning.

Representing and Using Domain Knowledge, Expert System Shells, Knowledge Acquisition .

Text Book 1: Ch 17 & 20.

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations **RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1: Identify AI based problems & AI techniques
CO2: Apply knowledge representation methods
CO3: AI Network Analysis
CO4: Apply Network process
CO5: Discuss on expert systems

Text Books:

1. E. Rich, K. Knight & S. B. Nair, Artificial Intelligence, 3/e, McGraw Hill.

Reference Books:

1. Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
2. Dan W. Patterson, Introduction to Artificial Intelligence and Expert systems-Prentice Hal of India.
3. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education, 2022.
4. Artificial Intelligence and Expert Systems Development by D W Rolston-Mc Graw hill.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	2									1	1	
CO2	1	1		1		2						3	1	1	
CO3	1	1		2	3								1	1	1
CO4	1	1		1	1	2							1	1	

V Semester

FUNDAMENTALS OF VIRTUAL REALITY			
Course Code:	22ECT505C	**CIE Marks:**	25
Teaching Hours/Week (L:T:P:S):	03:0:0:0	**SEE Marks:**	100
Total Hours of Pedagogy:	39	**Total Marks:**	125
Credits:	03	**Exam Hours:**	03 hrs

Course objectives:

1. To become familiar with the basic concepts of virtual reality Technology and input devices
2. To understand the output devices.
3. To study the concepts of Modeling in virtual
4. To understand the human factors in VR
5. To become familiar with the applications of VR

Module-1

INTRODUCTION: Three I's of virtual reality, commercial VR technology, five classic components of a VR system.

Input Devices: 3D position trackers: Tracker Performance Parameters, Ultrasonic Trackers, Optical Trackers

Navigation and Manipulation interfaces: Tracker-Based Navigation/Manipulation Interfaces, Trackballs, 3D Probes.

Text book1: 1.1, 1.3, 1.5, 2.1: 2.1.1, 2.1.4,2.1.5,2.1.6, 2.2: 2.2.1, 2.2.2,2.2.3

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-2

OUTPUT DEVICES: Graphics displays: Human Visual System.

Personal Graphics Displays: Head-Mounted, Hand-Supported, Floor-Supported and Desk Supported Displays.

Large-Volume Displays: Monitor-Based, Large-Volume, and projector Based Displays.

Sound displays: Human Auditory System, Convolvotron, Speaker-Based 3D Sound.

Text book1: 3.1: 3.1.1,3.1.2, 3.1.3, 3.2: 3.2.1, 3.2.2, 3.2.3

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-3

MODELING: Geometric modeling: Virtual Object Shape, Kinematics modeling: Homogeneous Transformation Matrices, Physical modeling: Collision Detection

Text book1: 5.1: 5.1.1, 5.2:5.2.1 and 5.3: 5.3.1

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-4

HUMAN FACTORS: Methodology and terminology: Data Collection and Analysis, Usability Engineering Methodology

User performance studies: Testbed Evaluation of Universal VR Tasks.

VR health and safety issues: Direct Effects of VR, Simulations on Users, Cyber sickness,

Text book1: 7.1:7.1.1,7.1.2, 7.2:7.2.1 and 7.3:7.3.1,7.3.2,7.3.3,7.3.4.

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-5

APPLICATIONS: Medical applications, Education, arts and entertainment, Military applications, Robotics applications.

Text book1: 8.1,8.2, 8.3 and 9.2

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Course outcomes:

At the end of the course the student will be able to:

- CO1 Describe the basic concepts of virtual reality and input devices.
- CO2 Compare the input and output devices
- CO3 Use the virtual reality modeling techniques
- CO4 Illustrate the human factors in virtual reality
- CO5 Understanding and identifying the applications of virtual reality

Assessment Details (both CIE and SEE):

CIE=50Marks:

Two assignments are evaluated for 5 marks: Assignment -1 from Units 1 and 2. Assignment -2 from Units 3, 4 and 5

Group Activity evaluated for 5 marks

SEE=100Marks

Suggested Learning Resources:

Text Books:

1: Virtual Reality Technology, Second Edition, Gregory C. Burdea& Philippe Coiffet, John Wiley & Sons. 3rd edition 2024

2: Introduction to Virtual Reality, John Vince, Springer, London, Springer-Verlag London Limited 2004

Reference Books (if required)

1: Virtual Reality Systems. John Vince, Pearson Education, 2007

Web Links: https://doi.org/10.1007/978-0-85729-386-2, 978-1-85233-739-1

www.nptelcoursematerial

www.youtube/virtual

Introduction - Learning Virtual Reality [Book] (oreilly.com)

https://www.geeksforgeeks.org/virtual-reality-introduction

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Creating VR environment using Unity 3D tool

Activity 2: Creating VR environment using Unreal engine tool

Activity 3: Creating VR environment using Mycraft or Cospace tool

Activity 4: Creating VR environment using Blender tool

Activity 5: Creating VR environment using A-Frame tool

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	03						01							01	
CO2	03						01							01	
CO3	03		02		02		01					01	02	01	01
CO4	03						01							01	
CO5	03		02			03	01							02	

High-3, Medium-2, Low-1

V Semester

MULTICORE ARCHITECTURE			
Course Code:	22ECT505D	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Provide the knowledge of Multi–core Architecture.
2. Understand the importance of Threading in systems.
3. Cover the Fundamental Concepts of Parallel Programming.
4. Understand the Threading and Parallel Programming Constructs.
5. Explain the different aspects of OpenMP in the context of threading.

Module-1	**08 hrs**
Introduction to Multi–core Architecture: Motivation for Concurrency in software, Parallel Computing Platforms, Parallel Computing in Microprocessors, Differentiating Multi–core Architectures from Hyper–Threading Technology, Multithreading on Single–Core versus Multi–Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. **Text 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**07 hrs**
System Overview of Threading: Defining Threads, System View of Threads, Threading above the Operating System, Threads inside the OS, Threads inside the Hardware, What Happens When a Thread Is Created, Application Programming Models and Threading, Virtual Environment: VMs and Platforms, Runtime Virtualization, System Virtualization. **Text 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**07 hrs**
Fundamental Concepts of Parallel Programming: Designing for Threads, Task Decomposition, Data Decomposition, Data Flow Decomposition, Implications of Different Decompositions, and Challenges You will Face, Parallel Programming Patterns. **A Motivating Problem:** Error Diffusion, Analysis of the Error Diffusion Algorithm. **An Alternate Approach:** Parallel Error Diffusion, Other Alternatives. **Text 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**07 hrs**
Threading and Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, Synchronization Primitives, Semaphores, Locks, Condition Variables, Messages, Flow Control–based Concepts, Fence, Barrier, Implementation dependent Threading Features. **Text 1**	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	10 hrs

OpenMP: A Portable Solution for Threading, Challenges in Threading a Loop, Loop–carried Dependence, Data–race Conditions, Managing Shared and Private Data, Loop Scheduling and Portioning, Effective Use of Reductions, Minimizing Threading Overhead, Work–sharing Sections, Performance–oriented Programming, Using Barrier and No wait, Interleaving Single– thread and Multi– thread Execution, Data Copy–in and Copy–out, Protecting Updates of Shared Variables, Intel Task queuing Extension to OpenMP, OpenMP Library Functions, OpenMP Environment Variables, Compilation, Debugging, performance.

Text 1

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Apply the knowledge of multi-core architectures to solve the parallel programming problems.
CO 2 - Analyse the concept of threads creation, flow of threads among different cores of the CPU.
CO 3 - Solve the different challenges of parallel programming.
CO 4 - Apply the knowledge gained to solve different Parallel Programming Constructs.
CO 5 - Create the threads to run on the multicore systems with the knowledge of OpenMP.

Suggested Learning Resources:

Text Books:

1. Shameem Akhter and Jason Roberts "Multicore Programming, Increased Performance through Software Multi–threading" Intel Press, 2006.ISBN 0-9764832-4-6.

Reference Books:

1. Calvin Lin, Lawrence Snyder, "Principles of Parallel Programming" Pearson Education, 2009. ISBN-13: 978-0321487902.
2. Michael J. Quinn, "Parallel Programming in C with MPI and OpenMP", Tata McGraw Hill, 2004. ISBN 13: 9780070582019.
3. David E, Culler, Jaswinder Pal Singh with Anoop Gupta "Parallel Computer Architecture A Hardware/ Software Approach", eBook ISBN: 9780080573076 Hardcover ISBN: 9781558603431.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	2										
CO2	3	2	2	1	2										
CO3	3	3	2	1	2										
CO4	3	2	2	1	2										
CO5	3	2	2	1	2										

High-3, Medium-2, Low-1

V Semester

ADVANCED CONTROL SYSTEMS			
Course Code:	**22ECT505E**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52 Hours	**Total Marks:**	100
Credits:	3 (3:0:0)	**Exam Hours:**	03 Hrs

Course objectives:

From this course, the students can learn

1. Basic concepts of state space representation and analysis.
2. Designing of state feedback controllers.
3. Analysing non-linear systems
4. Stability analysis of linear and non-linear systems.

Module-1

State Variable Description (8 hours)

Introduction, The concept of state, state equations for dynamic systems, time invariance and linearity, nonuniqueness of state model. State diagram, linear continuous time models, nonlinear models, local linearization of nonlinear models.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-2

Solution of state equations (10 hours)

Introduction, Existence and uniqueness of solution to continuous time state equations, solution of nonlinear continuous time state equations, solution of linear time varying continuous time state equations, solution of linear time invariant continuous time state equations.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-3

Controllability and observability (8 hours)

Introduction, General Concept of controllability, general concept of observability, controllability and observability test for continuous time systems. Controllability and observability state model in Jordan canonical form.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-4

Stability (8 hours)

Introduction, equilibrium points, stability concepts and definitions, Stability of LTI Systems, Stability of nonlinear continuous autonomous systems, the direct method of Lyapunov and the linear continuous time autonomous systems. Use of Lyapunov functions to estimate transients.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-5

Model Control (8 hours)

Introductions, controllable and observable companion forms, the effect of state feedback on controllability and observability, pole placement of state feedback, full order observers, reduced order observers, deadbeat control by state feedback, deadbeat observers.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Course outcomes:

At the end of the course the student will be able to:.3

CO1. Develop the state variable representation of physical systems

CO2. Evaluate the solution of state equations

CO3. Test the controllability and observability for continuous time systems.

CO4. Apply Lyapunov's method for the stability analysis of physical systems.

CO5. Analyse the effect of state feedback of control systems.

Assessment Details (both CIE and SEE):

Suggested Learning Resources:

Text Books:

Text book 1: Gopal M, Modern Control System Theory, 2/e, New Age Publishers, Reprint 2005.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Quizzes

Activity 2: Seminars

Activity 3: Simulation using MATLAB

Activity 4: Case studies

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2	3		
CO2	3	3	2									2	3		
CO3	3	3	2									2	3		
CO4	3	3	2									2	3		
CO5	3	3	2									2	3		

High-3, Medium-2, Low-1

V Semester

PROGRAMMING WITH PYTHON			
Course Code:	**22ECT505F**	**CIE Marks:**	40+5+5
Teaching Hours/Week (L:T:P:S):	**3: 0: 0**	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	3	**Exam Hours:**	3

Course objectives:

1. To acquire the fundamentals of Python programming language.
2. To attain an understanding of functions and collection types.
3. To familiarize the concepts of sequence types, data structures, and error handling in Python.
4. To realize the concepts of object-oriented in Python.
5. To get familiarised with the concepts of file handling and regular expressions.

Unit-1

Introduction: Introducing Python, Setting Up Python in Windows, introducing IDLE.
Parts of Python programming: Identifiers, Variables, Keywords, statements and expressions, variables, operators, datatypes-Built-in datatypes, sequences in Python, indentation, comments, Input and Output statements.
Control Flow - if, if-elif-else, while loop, for loop, infinite loop, break, continue, return, and pass statements.

Teaching Learning Method:	Chalk and Talk, Power Point Presentation
RBT Level:	L1, L2, L3

Unit-2

Functions - Defining Functions, Calling Functions, positional Arguments, Keyword Arguments, Default Arguments, Variable-length arguments, Recursive Functions, Anonymous Functions, and Function Decorators.
Strings and Lists: Creation, Basic operations, built-in methods, del statement.

Teaching Learning Method:	Chalk and Talk, Power Point Presentation
RBT Level:	L1, L2, L3

Unit-3

Tuples, and Dictionaries: Creating Tuples, Accessing the Tuple Elements, Basic Operations on Tuples, Operations on Dictionaries, Dictionary methods, using foe loop with dictionaries, converting lists into dictionaries, Converting Strings into Dictionary,
Data Structures in Python: Linked Lists, Stacks, Queues, Deques. Programming Examples.
Exceptions: Errors in a Python Program, Exception Handling, The Except Block, User Defined Exceptions.

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Unit-4

Object Oriented Programming in Python: Features of Object -Oriented Programming System (OOPS), Creating a class, The Self Variable, constructor, Types of variables, Namespaces, Types of Methods, passing members of one class to another class, Inner classes.
Inheritance and Polymorphism: Constructors in Inheritance, overriding Super class constructors and methods, The super() method, Types of Inheritance: Single/Multiple, Method Resolution order, Polymorphism, Operator Overloading, Method overloading, Method Overriding. Programming Examples

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Unit-5

Files in Python: Types of files, Opening and closing file, Working with Text files, Working with Binary Files, with statements, Pickle in Python, The seek() and tell() methods, Random accessing Binary files, zipping, and unzipping Files, reading and writing to CSV files.

Regular Expressions: Regular Expression, Sequence Characters in Regular Expression, Quantifiers in Regular Expression, Special Characters in Regular Expression, Using Regular Expression on Files, Retrieving Information from a HTML File.

Teaching Learning Method:	Chalk and Talk, Power Point Presentation
RBT Level:	L1, L2, L3

Course outcomes:

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

CO1. Apply the knowledge of Python scripting elements, Python constructs, datatypes, to solve engineering problems.

CO2. Identify the problem to apply the concepts of control structures, functions and error handling to solve them using the Python programming language

CO3. Apply the knowledge of Python and use the language scripting elements to manage the data, build the data structures, and handle errors.

CO4. Designing the solution to real-world problems through object-oriented concepts such as Inheritance, Polymorphism, and operator overloading.

CO5. Demonstrating the concepts of file handling and regular expressions

Assessment Details (both CIE and SEE):

1. 3 CIE's will be conducted each one for 25 marks
2. Unit 1,2,3,4, and Unit 5 will have the internal choice

Suggested Learning Resources:

Text Books:

Textbook 1: Core Python Programming: Dr. R. Nageshwara Rao, Dream Tech Press,2018

Textbook 2: Introduction to Python Programming, Gowrishankar S, Veena A, CRC Press,2019

Reference Book 1: Think Python, Allen Downey, Green Tea Press.

Reference Book 2: Core Python Programming, W.Chun, Pearson.

Reference Book 3: Introduction to Python, Kenneth A. Lambert, Cengage

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Group activity for a group of 4 or 5 students -5 marks

Activity 2: Two assignments are evaluated for 5 marks: Assignment1 – From Unit 1 and 2, Assignment2 from units 3,4 and 5

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1				1					2		
CO2	2	2	3	1	2			1					2		
CO3	2	3	3	2	2			1					2		
CO4	2	3	3	1	2			1					2		
CO5	1	3	2	1	2			1					2		

High-3, Medium-2, Low-1

VI Semester

MICROWAVE AND ANTENNA			
Course Code:	22ECU601	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	03:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	3Hrs

Course objectives:

1. Understanding the basics of microwave and waveguides.
2. Understanding the concepts of microwave networks, microwave passive devices and semiconductor devices.
3. Understanding microwave tubes, microwave design principles and antenna basics.
4. Understanding the importance of point sources, arrays and radiations from wires.
5. To understand different types of antennas like aperture, reflector, broadband and Microstrip antennas.

Module-1

Introduction to Microwaves -History of Microwaves, Microwave Frequency bands, applications of Microwaves, Losses associated with microwave transmission, Concept of Impedance in Microwave transmission.

Waveguides-Rectangular waveguide, Introduction to Circular waveguide (No derivations and Numerical examples), Strip line, Micro strip line.

TEXT 1,2

Teaching Learning Method:	Chalk and Talk, YouTube videos
RBT Level:	L1, L2

Module-2

Microwave Network Analysis - Network parameters for microwave circuits, Scattering Parameters. Microwave Passive devices and semiconductor Devices - Microwave passive devices - Power Divider, Magic Tee, Directional Coupler, Attenuator. Microwave Semiconductor Devices - Gunn Diodes, IMPATT diodes, PIN diodes.

TEXT 1,2

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-3

Microwave Tubes: Klystron- two cavity klystron amplifier and reflex klystron (klystron oscillator) **Antenna Basics** - Physical concept of radiation, near and far field regions, basic antenna parameters: radiation patterns, beam area, radiation Intensity, beam efficiency, reciprocity, directivity and gain, antenna apertures, effective aperture, bandwidth ,radiation efficiency, radio communication Link and antenna field zones.

TEXT 1,2,3.4

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2

Module-4

Radiations from wires: Short electric dipole, resistance of dipole, Half wave dipole antenna, folded dipole antennas.

Point Sources & their arrays - Arrays, Point source, Power theorem and its application, Examples of power patterns, Field patterns, Phase patterns, Array of isotropic point sources different cases, non-isotropic sources, principle of pattern multiplication, linear arrays of n elements of equal amplitude & spacing, broad side, end fire arrays

TEXT 3,4

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2,L3

Module-5

Aperture and Reflector Antennas- Babinet's principle, Radiation from sectoral and pyramidal horns :design concepts , parabolic reflector.

Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas. Micro strip Antennas- Basic characteristics of micro strip antennas, feeding methods
TEXT 3,4

Teaching Learning Method:	Lecture-based learning and Group learning
RBT Level:	L1, L2, L4

Practical Component

Experiment No	Laboratory Experiments	No of Hours	Blooms Taxonomy level.
	Hardware Experiments		
1	Measurement of frequency, guide wavelength and attenuation in a microwave Test bench.	2	L3, L4
2	Measurement of VSWR and reflection coefficient and attenuation in a microwave test bench setup	2	L3, L4
3	Measurement of Coupling and Isolation characteristics of directional coupler	2	L3, L4
4	To perform S - matrix characterization of E-Plane Tee and H-Plane Tee	2	L3, L4
5	To perform S – matrix characterization of Magic Tee	2	L3, L4
6	To perform an experiment to Calculate the aperture of a Dipole Antenna.	2	L3, L4
	Simulation Experiments (Virtual Labs)		
1	To study the characteristics of Reflex Klystron	2	L3, L4
2	To plot the V- I characteristics of GUNN diode	2	L3, L4
3	To study the basic properties of E-plane Tee , H-plane Tee and Magic Tee	2	L3, L4
4	To measure the scattering parameters of Circulators	2	L3, L4
5	To study the characteristics of Multi hole Directional coupler by measuring coupling factor & directivity of coupler	2	L3, L4
6	To study the properties of Magic Tee & determining the scattering parameters of Magic Tee	2	L3, L4

STUDY EXPERIMENTS:

1	Measurement of directivity and gain of micro strip patch antenna using printed dipole.	2	L3, L4
2	Measurement of directivity and gain of Yagi antenna (printed) using printed dipole.	2	L3, L4

Course outcomes:

At the end of the course the student will be able to:

CO1. Identify the microwave frequency band, its applications and different types of waveguides
CO2. Analyse microwave networks, microwave passive devices and semiconductor devices.
CO3. Apply microwave design principle, microwave tubes and antenna basics.
CO4. Be able to analyse the radiation patterns from different types of wires, point sources and their arrays.
CO5. Illustrate and design antennas like aperture, reflector, and broadband. Microstrip antenna.

Suggested Learning Resources:

Text Books:

1. Collin RE. Foundations for microwave engineering. John Wiley & Sons; 2007.
2. Annapurna Das, Sisir K Das, Microwave Engineering, TMH Publication, 2009
3. J.D. Kraus, Antennas and wave propagation, McGraw Hill, 5th edition 2017.
4. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 2007.

Reference Books

1. Microwave Devices and circuits- Liao / Pearson Education. 1992
2. M.Kulkarni., "Microwave devices and Radar Engg."Umesh Publications, 2011
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. I.J. Bahl and P. Bhartia, Micro Strip Antennas, Artech House, 1980.

Web Links:

1. www.nptel.in
2. https://www.academia.edu/12559664/Collin_Foundations_for_Microwave_Engineering
3. https://www.academia.edu/13759443/Basic_Antennas_Understanding_Practical_Antennas_and_Design_Joel_R_Hallas_2009
4. www.youtube/microwave , www.youtube/antennas

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Activity 1: Creating physical modules

Activity 2: Exploring new technologies and presenting

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1												2	
CO2	3	3	2											2	
CO3	3	2	3	2			1					1	2	2	
CO4	3	3	2	2			1					1	2	2	
CO5	3	3	2	2			1					1	2	2	

High-3, Medium-2, Low-1

VI Semester

CMOS VLSI DESIGN			
Course Code:	21ECT602	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	4:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	52	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:
1. Impart knowledge of MOS transistor theory and CMOS technology
2. Learn the operation principles and analysis of inverter circuits.
3. Infer the operation of Semiconductor memory circuits.
4. Demonstrate the concept of CMOS testing.

Module-1	**08 hrs**
Introduction: MOS Transistors, CMOS Logic (1.3 to 1.4 of TEXT1) **MOS Transistor Theory:** Introduction, Long-channel I-V Characteristics, Nonideal I-V Effects (2.1, 2.2, 2.4 TEXT3).	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**
Fabrication: CMOS Fabrication and Layout(1.5 TEXT1) CMOS Inverter DC Characteristics, Beta Ratio Effect, Noise Margin, Pass Transistors (2.5 TEXT1) **Delay:** RC Delay Model, Linear Delay Model, Logical Efforts of Paths (4.3 to 4.5 of TEXT1)	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
CMOS Logic Structures: Dynamic CMOS Logic, CMOS Domino Logic, BiCMOS Circuit Operation, Cascaded Voltage Switch Logic (CVSL). **Semiconductor Memories:** Operation of Three Transistor DRAM, Operation of One Transistor DRAM Cell, DRAM Operation Modes and Read/Write Operation of SRAM, Nonvolatile Memory(4*4 NOR AND NAND Based ROM array) (Text 2)	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**
Datapath Subsystem I: Single bit addition, carry generation & propagation, PG Carry-Ripple Addition**,** Manchester carry chain adder, carry skip adder, and carry select, conditional sum adders. **DataPath Subsystems II:** Unsigned Array Multiplication, 2's Complement Array Multiplication (Modified Baugh-W34eooley two's complement Multiplier), Booth encoding (Radix 4). (Text 1).	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**08 hrs**
Sequential MOS Logic Circuitry: SR Latch Circuitry, Clocked latch and Flip Flop Circuitry, CMOS D-Latch and Edge Triggered Flip-Flop.	

(Text 2)

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:
At the end of the course the student will be able to:

CO1. Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.
CO2. Draw the basic gates using the stick and layout diagram with the knowledge of physical design aspects.
CO3. Interpret memory elements along with timing considerations.
CO4. Design of Adder and Multiplier circuits using MOS transistors
CO5. Demonstrate ability to design Combinational, sequential and dynamic logic circuits.

Suggested Learning Resources:

Text Books:
1: "CMOS VLSI Design- A Circuits and Systems Perspective", Neil H E Weste, and David Money Harris 4th Edition, Pearson Education. 2015
2: "CMOS Digital Integrated Circuits: Analysis and Design", Sung Mo Kang & Yosuf Leblebici, Third Edition, Tata McGraw-Hill, 2019.
3: "CMOS VLSI design- A circuits and systems perspective", Neil H.E Weste, David Harris, Ayan Banerjee**,** Third edition Pearson Education (Asia) Pvt. Ltd, 2006

Reference Books:
1: "Basic VLSI Design", Douglas A Pucknell, Kamran Eshraghian, 3rd Edition, Prentice Hall of India publication, 2005.
2: R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", edition, John Wiley India Pvt. Ltd, year

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3		2								1	1	1
CO2	3	3	2										1	1	1
CO3	3	2	1										1	1	1
CO4	3	3	2										1	1	1
CO5	3	2	3										1	1	1

High-3, Medium-2, Low-1

VI Semester

SATELLITE COMMUNICATION			
Course Code:	22ECT603A	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. To be able to familiar with satellite systems and laws governing satellite orbit.
2. To understand concept of geostationary orbit and various losses on signal transmission in satellite system.
3. To evaluate link power budget estimation, System noise and various space segment subsystems.
4. To study earth segment, interference between satellite circuits and multiple access systems.
5. To understand Direct Broadcast System, Satellite mobile and specialized services.

Module-1	**08 hrs**
Over View Of Satellite Systems: Introduction, frequency allocation, INTELSAT, Orbits and launching methods: Kepler's laws, definitions of terms for earth orbiting satellites. Orbital element, apogee and perigee heights, orbit perturbations, inclined orbits, calendars, universal time, sidereal time, orbital plane, local mean time and sun synchronous orbits. Numerical problems. **Text 1, Reference 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-2	**08 hrs**
Geostationary Orbit: Introduction, antenna, look angles, polar mount antenna, Limits of visibility, earth eclipse of satellite, sun transit outage, launching orbits. Numerical problems. **Text 1 , Ref. 1**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-3	**08 hrs**
Space Segment: Introduction, power supply unit, attitude control: spinning satellite stabilization, momentum wheel stabilization. Station keeping, thermal control, TT&C subsystem. **Space Link:** Introduction, EIRP, transmission losses: free space transmission, feeder losses, and antenna misalignment losses. **Text 1, Ref. 2**	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3
Module-4	**08 hrs**
Earth Segement: Introduction, receive only home TV system: out-door unit, indoor unit, MATV, CATV, Tx – Rx earth station. Text 1 **Interference And Satellite Access:** Introduction, interference between satellite circuits. **Text 1**	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3
Module-5	**08 hrs**

Direct Broadcast Satellite Services:

Introduction, orbital spacing, power rating and number of transponders, frequency and polarization, transponder capacity, bit rates for digital TV, Satellite Services: satellite mobile services, VSAT, RadarSat, Global positioning satellite system.

Text 1

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Identify the characteristics of satellite communication Orbits, Launching Methods and channels.

CO 2 - Explain the concept of geostationary orbit and mathematical model for various losses on signal transmission in satellite system.

CO 3 - Apply analytical and empirical models in the design of satellite networks and space segments. Able to compute link power budget estimation, System noise.

CO 4 - Illustrate the multiple access schemes for satellite access.

CO 5 - Compile the Direct Broadcast System, satellite mobile and specialized services

Suggested Learning Resources:

Text Books:

1. Dennis Roddy, "Satellite Communications",4th Edition, McGraw- Hill International edition, 2006,

Reference Books:

1. Timothy Pratt, Charles Bostian and Jeremy Allnutt, "Satellite Communications", 2nd Edition, John Wiley Pvt. Ltd & Sons, 2008.
2. W. L. Pitchand, H. L. Suyderhoud, R. A. Nelson. , "'Communication Systems"", 2nd Edition, Pearson Education , 2007

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3													
CO2	2	2				3									
CO3		2				3						2			
CO4		2				3						3			
CO5		3				3						3			

High-3, Medium-2, Low-1

VI Semester

CRYPTOGRAPHY			
Course Code:	22ECT603B	**CIE Marks:**	40+5+5
Teaching Hours/Week (L:T:P:S):	3: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	3	**Exam Hours:**	03

Course objectives:

This course will enable students to:

- Preparation: To prepare students with fundamental knowledge/ overview in the field of Information Security with knowledge of mathematical concepts required for cryptography.
- Core Competence: To equip students with a basic foundation of Cryptography by delivering the basics of symmetric key and public key cryptography and design of pseudo random sequence generation technique

Module-1	**08 hrs**
Basic Concepts of Number Theory and Finite Fields: Divisibility and The Division Algorithm Euclidean algorithm, Modular arithmetic, Groups, Rings and Fields, Finite fields of the form GF(p), Polynomial Arithmetic, Finite Fields of the Form GF(2m) (Text 1: Chapter 3)	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique Programming on implementation of Euclidean algorithm, multiplicative inverse, Finite fields of the form GF(p), construction of finite field over GF(2m).
RBT Level:	L1, L2, L3

Module-2	**08 hrs**
Introduction: Computer Security Concepts, A Model for Network Security (Text 1: Chapter 1) **Classical Encryption Techniques**: Symmetric cipher model, Substitution techniques, Transposition techniques (Text 1: Chapter 1)	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Programming on Substitution and Transposition techniques. Self-study topics: Security Mechanisms, Services and Attacks.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
Block Ciphers: Traditional Block Cipher structure, Data encryption standard (DES) (Text 1: Chapter 2: Section1, 2) The AES Cipher. (Text 1: Chapter 4: Section 2, 3, 4) **More on Number Theory**: Prime Numbers, Fermat's and Euler's theorem, discrete logarithm. (Text 1: Chapter 7: Section 1, 2, 5)	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of SDES using programming languages like C++/Python/Java/Scilab. Self-study topics: DES S-Box- Linear and differential attacks
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

ASYMMETRIC CIPHERS: Principles of Public-Key Cryptosystems, The RSA algorithm, Diffie – Hellman Key Exchange, Elliptic Curve Arithmetic, Basics of Elliptic Curve Cryptography (Text 1: Chapter 8, Chapter 9: Section 1, 3, 4)	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of Asymmetric key algorithms using programming languages like C++/Python/Java/Scilab. Numerical examples on Elliptic Curve Cryptography
RBT Level:	L1, L2, L

Module-5	**08 hrs**

Pseudo-Random-Sequence Generators and Stream Ciphers: Linear Congruential Generators, Linear Feedback Shift Registers, Design and analysis of stream ciphers, Stream ciphers using LFSRs, A5. (Text 2: Chapter 16)	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. Implementation of simple stream ciphers using programming languages like C++/Python/Java/Scilab.
RBT Level:	L1, L2, L3

Course outcomes:

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

At the end of the course the student will be able to:

1. Explain traditional cryptographic algorithms of encryption and decryption process.
2. Use symmetric and asymmetric cryptography algorithms to encrypt and decrypt the data.
3. Apply concepts of modern algebra in cryptography algorithms.
4. Design pseudo random sequence generation algorithms for stream cipher systems.

Suggested Learning Resources:

Text Books:

1. William Stallings , "Cryptography and Network Security Principles and Practice", Pearson Education Inc., 6th Edition, 2014, ISBN: 978-93-325-1877-3

2. Bruce Schneier, "Applied Cryptography Protocols, Algorithms, and Source code in C", Wiley Publications, 2nd Edition, ISBN: 9971-51-348-X.

Reference Books:

1. Cryptography and Network Security, Behrouz A Forouzan, TMH, 2007.

2. Cryptography and Network Security, Atul Kahate, TMH, 2003

Weblink:

https://nptel.ac.in/courses/106105031

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

High-3, Medium-2, Low-1

VI Semester

MACHINE LEARNING			
Course Code:	**22ECT603C**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Acquire some concepts and techniques that are core to Machine Learning.
2. Understand learning and decision trees.
3. Acquire knowledge of neural networks, Bayesian techniques and instant based learning.
4. Understand analytical learning and reinforced learning.

Module-1	**08 hrs**
Introduction: Need of Machine Learning ,Examples of Machine Learning Applications, **Supervised Learning**: Learning a Class from Examples, Learning Multiple Classes, Regression, Model Selection and Generalization, **Bayesian Decision Theory**: Introduction, Classification, Losses and Risks, Discriminant Functions, Association Rules.	
Teaching Learning Method: **RBT Level:**	Chalk and Talk, PowerPoint Presentation L1, L2, L3
Module-2	**08 hrs**
Parametric Methods & Clustering: Introduction, Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression, Model Selection Procedures. **Clustering**: k-Means Clustering, Spectral Clustering, Hierarchical Clustering, Choosing the Number of Clusters **Nonparametric Methods**: Nonparametric Density Estimation, Condensed Nearest Neighbor, Distance - Based classification, Outlier Detection.	
Teaching Learning Method: **RBT Level:**	Chalk and Talk, PowerPoint Presentation L1, L2, L3, L4
Module-3	**08 hrs**
Decision Trees & Linear Discrimination: Introduction, Univariate Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees. **Linear Discrimination:** Introduction, Generalizing the Linear Model, Geometry of the Linear Discriminant, Gradient Descent, Discrimination by Regression. **Text**	
Teaching Learning Method: **RBT Level:**	Chalk and Talk, PowerPoint Presentation, YouTube videos L1, L2, L3, L4
Module-4	**08 hrs**
Multilayer Perceptrons: The Perceptron, Training a Perceptron, Multilayer Perceptrons, Backpropagation Algorithm, Training Procedures, Tuning the Network Size, Learrting Time, Deep Learning. **Kernel Machines**: v-SVM, Defining Kernels, Multiple Kernel Learning, Multiclass Kernel machines, Kernel machine for regression, Kernel machines for Ranking, One class Kernel machines. **Text**	

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations L1, L2, L3, L4

Module-5	**08 hrs**

Hidden Markov Models: Discrete Markov Processes, Hidden Markov Models

Case Studies based on Real Time applications: Facial recognition, Healthcare advancement, Email automation and spam filtering, predictive analysis, financial accuracy.

Text

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations **RBT Level:** L1, L2, L3, L4, L5

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Understand the core concepts of Machine learning.

CO 2 - Appreciate the underlying mathematical relationships within and across Machine Learning algorithms.

CO 3 - Explain paradigms of supervised and un-supervised learning.

CO 4 - Recognize a real-world problem and apply the learned techniques of Machine Learning to solve the problem.

CO 5 - Explain the need of machine learning concepts in real time applications.

Suggested Learning Resources:

Text Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd edition, The MIT Press, PHI Learning Pvt limited, 2018.

Reference Books:

1. Machine Learning-Tom M. Mitchell, McGraw-Hill Education, (Indian Edition), 2013.
2. The Elements of Statistical Learning-T. Hastie, R. Tibshirani, J. H. Friedman, Springer; 1st edition, 2001.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2					1								
CO2		3					1							2	
CO3					1	1	1								
CO4					1	1	1				2				
CO5					1	1	1		3		3			1	3

High-3, Medium-2, Low-1

Semester VI

DIGITAL IMAGE PROCESSING			
Course Code:	22ECT603D	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

- Understand the fundamentals of digital image processing.
- Understand the image transform used in digital image processing.
- Understand the image enhancement techniques in spatial domain used in digital image processing.
- Understand the Color Image Processing and frequency domain enhancement techniques in digital
- Image processing.
- Understand the image restoration techniques and methods used in digital image processing.

Module-1	**08 hours**
Digital Image Fundamentals: What is Digital Image Processing?, Origins of Digital Image Processing, Examples of fields that use DIP, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels. [Text 1: Chapter 1, Chapter 2: Sections 2.1 to 2.5]	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	**L1,L2**
Module-2	**08 hours**
Image Transforms: Introduction, Two-Dimensional Orthogonal and Unitary Transforms, Properties of Unitary Transforms, Two-Dimensional DFT, cosine Transform, Haar Transform. Text 2: Chapter 5: Sections 5.1 to 5.3, 5.5, 5.6, 5.9]	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	**L1,L2.**
Module-3	**09 hours**
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters [Text: Chapter 3: Sections 3.2 to 3.6].	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	**L1,L2,L3**
Module-4	**08 hours**
Frequency Domain: Basics of Filtering in the Frequency Domain, Image Smoothing and Image Sharpening Using Frequency Domain Filters. **Color Image Processing:** Color Fundamentals, Color Models, Pseudo-color Image Processing. [Text 1: Chapter 4: Sections 4.7 to 4.9 and Chapter 6: Sections 6.1 to 6.3]	
Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	**L1,L2, L3**
Module-5	**07hours**

Restoration: A model of the Image Degradation/Restoration Process, Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Inverse Filtering, Minimum Mean Square Error (Wiener) Filtering.
[Text 1: Chapter 5: Sections 5.1, to 5.4.3, 5.7, 5.8]

Teaching Learning Method:	Chalk and Talk, power point presentation, animations, videos
RBT Level:	**L1,L2,L3**

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand image formation and the role of human visual system plays in perception of gray and Color image data.

CO2.Compute various transforms on digital images.

CO3.Conduct independent study and analysis of Image Enhancement techniques.

CO4.Apply image processing techniques in frequency (Fourier) domain.

CO5.Design image restoration techniques.

Suggested Learning Resources:

Text Books:

1. Digital Image Processing- Rafael C Gonzalez and Richard E Woods, PHI, 3rd Edition 2010.
2. Fundamentals of Digital Image Processing- A K Jain, PHI Learning Private Limited 2014.

Reference Book:

Digital Image Processing- S Jayaraman, S Esakkirajan, T Veerakumar, Tata McGraw Hill, 2014.

Web links and Video Lectures (e-Resources)

- Image databases, https://imageprocessingplace.com/root_files_V3/image_databases.htm
- Student support materials, https://imageprocessingplace.com/root_files_V3/students/students.htm
- NPTEL Course, Introduction to Digital Image Processing, https://nptel.ac.in/courses/117105079
- Computer Vision and Image Processing, https://nptel.ac.in/courses/108103174
- Image Processing and Computer Vision – Matlab and Simulink,
- https://in.mathworks.com/solutions/image-video-processing.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Verilog /VHDL coding for Image manipulation.
- Simulink models for Image processing.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		1								1	2	1
CO2	3	2	2		1								1	2	1
CO3	3	3	2		1								1	2	1
CO4	3	1	2		1								1	2	1
CO5	3	1	1		1								1	2	1

High-3, Medium-2, Low-1

VI Semester

ROBOTICS AND MACHINE VISION SYSTEM			
Course Code:	**22ECT603E**	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand various elements of robotic system and how they integrate.
2. Analyse various operations of robot end effectors.
3. Understand applications various sensors in robotics
4. Introduce robot mechanics and artificial intelligence.
5. Understand the fundamentals of machine vision

Module-1

FUNDAMENTALS OF ROBOTICS: Automation and Robotics, Robotics in science Fiction, A brief history of robotics, Robot Anatomy, Work volume, Robot drive systems, Control systems and Dynamic performance, Precision of movement, End effectors, Robotic sensors, Robot applications *TEXT 1* .

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-2

ROBOT END EFFECTORS: Introduction, Types of end effectors, Mechanical gripper, Other types of grippers, Tools as end effectors, The Robot/End effectors interface, Considerations in gripper selection and design.

SENSORS IN ROBOTICS: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors, miscellaneous sensors and sensor-based system. Use of sensors in Robotics. *TEXT 1.*

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-3

ROBOT MECHANICS: Introduction to manipulator kinematics, homogeneous transformation and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller.

MACHINE VISION FUNDAMENTALS: Introduction to machine vision, the sensing and digitizing function in machine vision, Image processing and Analysis. *TEXT 1.*

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-4

ROBOT PROGRAMMING: Methods of robot programming, leadthrough programming methods, a robot program as a path in space, motion interpolation, WAIT, SIGNAL and DELAY commands, branching.

ARTIFICIAL INTELLIGENCE: Introduction, goals of AI research, AI techniques, LISP programming, AI and Robotics**.**

TEXT 1.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-5

ROBOT APPLICATIONS IN MANUFACTURING: Material transfer and machine loading/unloading. Processing operations.

TEXT 1.

Teaching Learning Method:	Chalk and talk method, Power point presentation

RBT Level:	L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. understand basic knowledge of, various robotic elements, end effectors and various sensors that can be used in robotics.

CO2. Analyse the robot mechanics using homogeneous transformation.

CO3. Apply the robotic principles to build a new artificially intelligent system.

CO4. Study the importance of Artificial Intelligence and robotics.

CO5. Analyse the fundamentals of machine vision.

Suggested Learning Resources:

Text Books:

1. M.P. Groover, M. Weiss, R.N. Nagel, N.G. Odrey, "Industrial Robotics-Technology, Programming and Applications", Tata McGraw-Hill Education Pvt Ltd,, 2008

Reference Books

1. R.K.Mittal, I.J.Nagrath, Robotics and controls, Tata McGraw Hill Education Pvt.
2. Sathya Ranjan Deb, "Robotics Technology and flexible Automation", 6th Edition, TMH, 2003.

Web Links:

1. http://www.galileo.org/robotics/intro.html
2. http://www.columbiaokura.com/blog/blog/2013/10/14/types-of-robotic-end-effectors-(end-of-arm-tools)
3. http://nptel.ac.in/courses/112103174/39

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2						1			
CO2	2	2		2	2							1			
CO3	2	2				2						1			
CO4	2	2			2	2						1			
CO5	2	2		2	2	2						1			

High-3, Medium-2, Low-1

VI Semester

ADAPTIVE SIGNAL PROCESSING			
Course Code:22ECT603F	**22ECT603F**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	3 Hours

Course objectives:

1. To understand the basic concept of adaptive filter and adaptive system.
2. To be able to identify the geometrical significance of Eigenvectors and values
3. To analyze the Simple, Newton's and Steepest descent Gradient search method to search performance surface
4. To study estimation of gradient component using Newton's, Steepest-descent methods and LMS algorithm
5. To be familiar with design of adaptive communication system, adaptive noise canceller and adaptive modelling in FIR digital filter synthesis

Module-1	**08 hrs**

ADAPTIVE FILTERS: The Filtering Problem, Linear Optimum Filters, Adaptive Filters, Linear filter structures, Approaches to the development of linear adaptive filters.

ADAPTIVE SYSTEMS: Definition and characteristics, Areas of application, General properties, Open- and closed-loop adaptation, Applications of closed-loop adaptation, Example of an adaptive system.

(TEXT 1&TEXT2)

Teaching Learning Method:	Chalk board/PPT/Classroom Discussion/Group activity
RBT Level:	L1, L2

Module-2	**08 hrs**

THE ADAPTIVE LINEAR COMBINER: General description, Input signal and weight vectors, Desired response and error, the performance function, gradient and minimum mean-square error, Example of a performance surface, Alternative expression of the gradient, Decorrelation of error and input components.

PROPERTIES OF THE QUADRATIC PERFORMANCE SURFACE: Normal of the input correlation matrix, Eigen values and Eigen vectors of the input correlation matrix, an example with two weights, geometrical significance of eigenvectors and Eigen values. (**TEXT2)**

Teaching Learning Method:	Chalk board/PPT/Classroom Discussion/Group activity
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

SEARCHING THE PERFORMANCE SURFACE: Methods of searching the performance surface, Basic ideal of gradient search methods, a simple gradient search algorithm and its solution, Stability and rate of convergence, The learning curve, and Gradient search by Newton's method in multidimensional space, Gradient search by the method of steepest descent, Comparison of learning curves.

(TEXT2)

Teaching Learning Method:	Chalk board/PPT/Classroom Discussion/Group activity
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

GRADIENT ESTIMATION AND ITS EFFECTS ON ADAPTATION:

Gradient component estimation by derivate measurement, the performance penalty, Derivative measurement and performance penalties with multiple weights, variance of the gradient estimate, effects on the weight-over solution.

THE LMS ALGORITHM: Derivation of the LMS algorithm, convergence of the weight vector, an example of convergence, learning curve, noise in the weight-vector solution, mis adjustment, performance.

(TEXT2)

Teaching Learning Method:	Chalk board/PPT/Classroom Discussion/Group activity
RBT Level:	L1, L2, L3

Module-5	**07 hrs**

ADAPTIVE MODELING AND SYSTEM IDENTIFICATION: General description, Adaptive modeling of multipath communication channel, adaptive modeling in geophysical exploration, Adaptive modeling in FIR digital filter synthesis.

ADAPTIVE INTERFACING CANCELING: The concept of adaptive noise canceling, stationary noise-canceling solutions, effects of signal components in the reference input, The adaptive interference canceller as a notch filter, The adaptive interface canceller as a high-pass filter.

TEXT2

Teaching Learning Method:	Chalk board/PPT/Classroom Discussion/Group activity
RBT Level:	L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand the basic concept of adaptive filter and adaptive system.

CO2. Understand the design of adaptive linear combiner and identify the geometrical significance of Eigenvectors and values.

CO3. Analyze the Simple, Newton's and Steepest descent Gradient search method to search performance surface.

CO4. Estimate the gradient component using Newton's, Steepest-descent methods and LMS algorithm.

CO5. Design of adaptive communication system, adaptive noise canceller and adaptive modeling in FIR digital filter synthesis.

Assessment Details (both CIE and SEE):

CIE:

There are three Internal Assessment Tests are conducted and evaluated for 50 Marks

Assignments: two to five number of assignments are given to the students and evaluated for 5 marks.

Quizzes: three quizzes are given to the students and evaluated for 5 marks.

Group Activity: one group activity for group of two to three students is given and evaluated for 5 marks.

SEE:

The semester End Examination for all the courses shall be conducted at the end of each semester with maximum Marks:100 and Duration: 3Hrs.

5 sets of questions with internal choice are prepared and each set are evaluated for 20Marks,

Suggested Learning Resources:

Text Books:

Text book 1: Simon Haykin: "Adaptive filter Theory", , Pearson Education Asia,4th edition- 2008.

Text Book 2: Bernard Widrow and Samuel D. Stearns: "Adaptive Signal Processing", Pearson Education Asia, 2009.

Reference Books (if required)

Reference Book 1: T. Adali and Simon Haykin, "Adaptive Signal Processing: Next Generation Solutions,"Wiley India, 2012.

Reference Book 2: Jophn R. Treichler C. Richard Johnson, Jr. and Michael G. Larimore, "Theory and Design of Adaptive Filters", Pearson Education / PHI 2002.

Web Links: https://archive.nptel.ac.in/courses/117/105/117105075/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
Activity 1: Group activity through implementation of circuit using MATLAB
Activity 2: Discussion of concepts in classroom through real time processing of model using MATLAB
Activity 3: Quiz

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											3	2	
CO2	3	3	3										3	2	
CO3	3	3	3										3	3	
CO4	3	3	3										3	3	
CO5	3	2	2	2									3	2	

High-3, Medium-2, Low-1

VI Semester

MECHATRONICS			
Course Code:	**22ECT604A**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40 Hours	**Total Marks:**	100
Credits:	3	**Exam Hours:**	03 Hrs

Course objectives:

From this course, the students can learn

1. Explaining the various building blocks of mechatronic systems with components of Mechatronic systems.
2. Study of the sensors and transducers.
3. Explaining signal conditioning techniques and actuation systems.
4. Controlling the mechatronic systems using digital logics, also explaining the inverts concepts.
5. Procedure for designing mechatronic system with few case studies.

Module-1

Introduction to Mechatronics, Measurement systems, and control systems.

Introduction to mechatronics and Measurement systems, Control Systems – Introduction, elements of control system, classification of control systems, transfer function, Open loop and closed loop control system, time response of control system, stability, frequency response, System Models – Mechanical systems, electrical systems, fluid systems, Thermal systems, time response, Control Modes – two step mode, P, D, I, PD, PI, and PID controllers, digital controllers.

Text Book1: 1.1, 1.2:1.2.1-1.2.10, 1.2.16-1.2.18, 5.1, 5.3

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2

Module-2

Sensors and Transducers

Sensors and transducers, performance terminology, potentiometer sensor, strain gauged element, capacitive element, Differential transformers, Eddy current proximity sensors, Optical encoders, Pneumatic proximity sensor, Hall effect sensors, incremental encoder, Piezoelectric sensors, tactile sensor, RTDs, thermistors, light sensors, Selection of sensors, inputting data by switches – Denouncing, Keypads.

Text Book2: 2.1, 2.2, 2.3.1, 2.3.2, 2.3., 2.3.4, 2.3.5, 2.3.7, 2.3.9, 2.3.10, 2.4.1, 2.6.1, 2.6.2, 2.9.2, 2.9.3, 2.10, 2.11, 2.12.

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2

Module-3

Signal Conditioning

Signal conditioning process, Operational Amplifier, Protection, Filtering, Digital Signals, Multiplexers, Data acquisition.

Electrical Actuation systems

Electrical systems, Mechanical switches, Solid state switches, DC Motors, AC Motors, Stepper motors,

Text Book2: 3.1-3.8, 7.1-7.7

Teaching Learning Method:	Chalk and Board, Problem Based Learning

RBT Level:	L1, L2
Module-4	
Digital Logic Combinational logic, Digital comparator, code converters, Sequential logic-flip-flops, Microprocessor, Microcontrollers, Programmable logic controllers, **Inverters** Introduction, Single-Phase Voltage Source Inverters, Current Source Inverters. **Textbook2:** 14.6.2, 14.6, 14.7. **Textbook1:** 7.2.1-7.2.4, 7.4, 7.5	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3
Module-5	
Design of Mechatronic Systems Mechatronic design Elements, Traditional and mechatronic designs, Embedded Systems, MEMS, Procedure for designing a mechatronic system, Engine Management system, Automatic camera, Automatic washing machine, Simple weighing machine, and Manual room temperature controller. **Text Book1: 8.1-8.6**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2
Course outcomes: **After successful completion of this course, the students will be able to** **CO1.** Explain the basic building blocks of Mechatronic systems and importance of Mechatronics. **CO2.** Describe the working principles of sensors and transducers used in the design of Mechatronic systems. **CO3.** Illustrate the signal conditioning methods and actuators for the Mechatronic Systems. **CO4.** Explain the digital logic principles and applications of inverters. **CO5.** Illustrate the design procedure and Case studies on real time mechatronic systems.	
Assessment Details (both CIE and SEE):	
Suggested Learning Resources: **Text Books:** **Text book 1:** R K Rajput, "A Textbook of Mechatronics", First edition, S. Chand and company Ltd., 2007. **Textbook 2:** W. Bolton, "Mechatronics" by W. Bolton, 3rd Edition, PEI, 2003.	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning **Activity 1:** Quizzes **Activity 2:** Seminars **Activity 3:** Simulation using MATLAB **Activity 4:** Case studies	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**-**									**2**	**3**		
CO2	**3**	**3**	**2**									**2**	**3**		
CO3	**3**	**3**	**3**									**2**	**3**		
CO4	**3**	**3**	**-**									**2**	**3**		
CO5	**3**	**3**	**2**									**2**	**3**		

High-3, Medium-2, Low-1

VI Semester

MICRO ELECTRO MECHANICAL SYSTEMS			
Course Code:	22ECT604B	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. **Preparation**: To prepare students with fundamental knowledge/ overview in the field of Micro Electro Mechanical Systems.
2. **Core Competence**: To equip students with a basic foundation in electronic engineering, mechanical engineering, electrical engineering, chemistry, physics and mathematics fundamentals required for comprehending the operation and application of MEMS circuits, design.
3. **Professionalism & Learning Environment:** To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Module 1	**08 hrs**

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems, Miniaturization, Applications and Markets.

Text1:**1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9**

Teaching Learning Method:	Chalk and talk method, Animation of MEMS products and applications.
RBT Level:	L1, L2, L3

Module 2	**08 hrs**

Working Principles of Microsystems: Introduction, Microsensors, Micro actuation, MEMS with Micro actuators, Micro accelerometers, Microfluidics.Text**1: 2.1,2.2,2.3,2.4,2.5,2.6**

Engineering Science for Microsystems Design and Fabrication: Introduction, Atomic Structure of Matter, Ions and Ionization Molecular Theory of Matter and Intermolecular Forces, Plasma Physics, Electrochemistry.**Text1: 3.1,3.2,3.3, 3.4, 3.7,3.8**

Teaching Learning Method:	Power Point Presentation, You Tube videos, Animations of MEMS Microsensors, Micro actuators, Micro accelerometers and Microfluidics, molecules, Ions and matter
RBT Level:	L1, L2, L3

Module 3	**08 hrs**

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Mechanical Vibration, Thermomechanics, Fracture Mechanics, Thin Film Mechanics, Overview on Finite Element Stress Analysis.**Text1:4.1,4.2,4.3,4.4,4.5,4.6,4.7**

Teaching Learning Method:	Chalk and talk method, Power Point Presentations and supporting You Tube Videos Solve numerical related to Thin Plates, and Vibration. Self-study topics: solve numerical related to the topics
RBT Level:	L1,L2, L3

Module 4	**08 hrs**

Scaling Laws in Miniaturization: Introduction, Scaling in Geometry, Scaling in Rigid-Body Dynamics, Scaling in Electrostatic Forces, Scaling in Electromagnetic Forces, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer. **Text1:6.1,6.2,6.3,6.4,6.5,6.6,6.7,6.8**	
Teaching Learning Method:	Chalk and Talk Method, You Tube Videos, Solve numerical related to scaling in Geometry Self-study topics: solve numerical of the topics
RBT Level:	L1, L2, L3

Module 5	**08 hrs**

Overview of Micromanufacturing: Introduction, Bulk Micro manufacturing, Surface Micro machining, The LIGA Process, Summary on Micro manufacturing. **Text1:9.1,9.2,9.3,9.4,9.5**

Microsystem Packaging: Introduction, Overview of Mechanical Packaging of Microelectronics, Microsystem Packaging. **Text1:11.1,11.2,11.3**

Teaching Learning Method:	Power Point Presentation, YouTube videos, Animation of MEMS micro manufacturing Supporting animation videos on packaging.
RBT Level:	L1, L2, L3

Course outcomes (Course Skill Set)

At the end of the course the student will be able to:

1. Appreciate the technologies related to Micro Electro- Mechanical Systems.
2. Understand design and fabrication processes involved with MEMS devices.
3. Analyze the MEMS devices and develop suitable mathematical models
4. Understand design of scaling factors in MEMS devices.
5. Know various application areas, mechanical packaging for MEMS devices.

Suggested Learning Resources:

Text Book:

1. Tai-Ran Hsu, MEMS and Microsystems: DesignandManufacture,1st Ed, Tata Mc Graw Hill.

Reference Books:

1. Hans H Gatzen, Volker Saile, JurgLeuthold, Microand Nano Fabrication: Tool sand Processes, Springer, 2015.
2. DilipKumar Bhattacharya, Brajesh Kumar Kaushik, Microelectromechanical Systems (MEMS), Cengage Learning.
3. Chang Liu, Foundations of MEMS, Pearson Ed.

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1: Develop mini projects and Final year projects using MEMS components to address the real-world problems

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2	3	
CO2	3	3	3		2								3	3	
CO3	3	3	3	2									1	3	
CO4		3	3				2						1	3	
CO5													1	2	

High-3, Medium-2, Low-1

Semester: VI

Real Time Operating Systems			
Course Code:	**22ECT604C**	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Impart the fundamental concepts of the OS and real time systems.
2. Expose to the concepts such as scheduling techniques, dynamic priority policies.
3. Describe the concepts such as blocking, deadlock, live lock & soft real-time services.
4. Impart the firmware components, debugging and reliability system design.
5. Expose to different available RTOS's through their analysis.

Module-1

Real-Time Systems and Resources: Real Time Systems, Real-Time Embedded Systems, Resource Analysis, Real-Time Service Utility, scheduling classes, Scheduler concepts, OS basics, Types of OS, OS in an embedded device, State transition diagram.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-2

Processing with Real Time Scheduling: Introduction, Pre-emptive Fixed Priority Scheduling Policies with timing diagrams, Problems and issues, Feasibility, Rate Monotonic least upper bound (No derivation), Necessary and Sufficient feasibility, Deadline Monotonic Policy, Dynamic priority policies.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-3

I/O Resources: Worst case execution time, Execution efficiency, I/O Architecture.
Memory: Physical hierarchy, Shared Memory, ECC Memory.
Multi-resource Services: Blocking, Deadlock and livelock, Priority inversion.
Soft real-time services: Missed deadline, QoS.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-4

Firmware Components: Boot Code, Device Drivers, Operating System Services, Communicating and Synchronized Services.
Single-Step Debugging: Task/process-level debugging, System/kernel-level debugging, Processor-level debugging.
High Availability and Reliability Design: Reliability and Availability Similarities and Differences, Reliability, Reliable Software, Available Software, Design Trade-Offs, Hierarchical Approaches for Fail-Safe Design.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Module-5

FreeRTOS Alternative to Proprietary RTOS, Future Directions for RTOS, RTOS Examples-LynxOS, OSE, QNX, VxWorks, Windows Embedded Compact, Embedded Linux, Embedded System Design with VxWorks, Comparison of available RTOS, Selection criteria of RTOS for an application.

Teaching Learning Method:	Chalk and talk method, Power point presentation
RBT Level:	L1, L2, L3

Course outcomes:
At the end of the course the student will be able to:

CO1. Discuss the fundamentals of various real time services, real time service utilities.
CO2. Apply static and dynamic scheduling techniques for the given real time system constraints.
CO3. Analyze deadlock, priority inversion, missed deadlines and QoS of real time embedded systems.
CO4. Analyse firmware components, debugging and high availability/reliability design concepts.
CO5. Choose the appropriate available OS to improve the real time embedded system performance.

Assessment Details (both CIE and SEE):
The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%.

Suggested Learning Resources:
Text Books:
Text book 1: Real-time Embedded Components and Systems", Sam Siewert, Cengage Learning.
Text Book 2:
Reference Books (if required)
Reference Book 1: "Real-time embedded components and systems with Linux and RTOS", Pratt, Siewert, Mercury Learning and Information, 2016
Reference Book 2: Shibu K V, **"Introduction to Embedded Systems"**, Tata McGraw Hill Education Private Limited, 2017
Web Links:

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning
Activity 1: Programming Assignments / Mini Projects can be given.
Activity 2:
Activity 3:

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2				2						1			
CO2	2	2		2	2							1			
CO3	2	2				2						1			
CO4	2	2			2	2						1			
CO5	2	2		2	2	2						1			

High-3, Medium-2, Low-1

VI Semester

ROBOTICS MECHANICS AND CONTROL			
Course Code:	**22ECT604D**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40 Hours	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03 Hrs

Course objectives:

From this course the students can learn

1. Terminologies and mathematical fundamentals of robotics mechanics and design.
2. Obtaining Kinematics and inverse kinematics of manipulators.
3. Study of manipulator dynamics and static forces.
4. Manipulator design and trajectory generation.
5. Incorporating control systems to improve the performance of manipulator.

Module-1

Introduction

Background, Terminologies, Descriptions, mapping, operators, summary of interpretations, transformation arithmetic, Transform equations, more on representation of orientation.

Text Book1:

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-2

Manipulator Kinematics

Link Description, Link Connection description, DH Parameters, Convention for affixing frames to links, Manipulator kinematics.

Inverse Manipulator Kinematics

Solvability, Algebraic and Geometric Solutions

Examples: Unimation PUMA 560, Yasukawa Motoman L-3.

Text Book1: 2.6, 2.7, 3.1 to 3.4, 3.6, 3.7

Teaching Learning Method:	Chalk and Board, Problem Based Learning
RBT Level:	L1, L2, L3, L4

Module-3

Jacobians: Velocities and static forces.

Notion for time varying position and orientation, Linear and rotational velocity of rigid bodies, motion of the links of a robot, velocity propagation from link to link, Jacobians, Singularities, Static force in manipulators.

Manipulator dynamics

Acceleration of a rigid body, Mass distribution, Newton's equation, Euler's equation, iterative newton-Euler dynamic formulation, iterative vs. closed form.

Text Book2: 5.1 to 5.3, 5.7, 5.8

Teaching Learning Method:	Chalk and Board, Problem Based Learning

RBT Level:	L1, L2, L3, L4
Module-4	
Trajectory Generation General considerations in path description and generation, Joint-space schemes, Cartesian-space schemes. **Manipulator Mechanism Design** Basing the design on task requirements, Kinematic configuration, quantitative measures of workspace attributes, redundant and closed chain structures, Actuation schemes, stiffness and deflections, position sensing and force sensing. **Text Book1: 7.1 to 7.3**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3, L4
Module-5	
Linear control of Manipulators. Feedback and closed loop control, second order linear systems, control of second order systems, control law partitioning, and trajectory following control, disturbance rejection, modelling and control of a single joint, Architecture of industrial robot controller. **Text Book3: 8.1, 8.2, 8.4, 8.6**	
Teaching Learning Method: **RBT Level:**	Chalk and Board, Problem Based Learning L1, L2, L3, L4
Course outcomes: **After successful completion of this course, the students will be able to** **CO1.** Explain the terminologies of robotic design, find the position and orientation of object on 3D space. **CO2.** Obtain the forward and inverse kinematic parameters. **CO3.** Obtain the robot dynamics with velocities, acceleration and force. **CO4.** Evaluate trajectories and explain the manipulator mechanism design. **CO5.** Analyse the linear control of manipulators.	
Assessment Details (both CIE and SEE):	
Suggested Learning Resources: **Text Books:** **Text book 1:** J. J. Craig, "Introduction to robotics Mechanics and control, PEI, 3rd Edition, 2009	
Activity Based Learning (Suggested Activities in Class)/ Practical Based learning **Activity 1:** Quizzes **Activity 2:** Seminars **Activity 3:** Simulation **Activity 4:** Case studies	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**-**	**-**									**3**	**3**	**2**	**2**
CO2	**3**	**2**	**2**									**3**	**3**	**2**	**2**
CO3	**3**	**2**	**2**	**1**								**3**	**3**	**2**	**2**
CO4	**3**	**2**	**2**	**1**								**3**	**3**	**2**	**2**
CO5	**3**	**2**	**2**	**1**								**3**	**3**	**2**	**2**

High-3, Medium-2, Low-1

VI Semester

VLSI LAB			
Course Code	22ECL606	**CIE Marks**	50
Teaching Hours/Week (L: T: P: S)	0:0:2:0	**SEE Marks**	50
Credits	01	**Exam Hours**	03

Course objectives:

This laboratory course enables students to

1. Design, model, simulate and verify CMOS digital circuits
2. Design layouts CMOS digital circuits
3. Perform physical verification of CMOS digital circuits
4. Perform RTL- flow and understand the stages in ASIC design.

Sl. No.	Experiments
1	DC, Transient analysis of CMOS logic-Universal gates schematic
2	DC, Transient analysis of CMOS full adder schematic
3	DC, Transient analysis of Pass transistor and transmission gates schematic
4	DC, Transient analysis of Sequential circuits schematic 1. Clocked D Latch 2. Master-Slave Edge Triggered Register
5	DRC and LVS analysis of CMOS Inverter layout
6	DRC and LVS analysis of Common Source Amplifier Layout
7	DRC and LVS analysis of Common Drain Amplifier Layout
8	DRC and LVS analysis of Differential Amplifier Layout
09	Synthesis and Simulation of Inverter using Verilog code
10	Synthesis and Simulation of Buffer Verilog code
11	Synthesis and Simulation of Basic/Universal Gate using Verilog code
12	Synthesis and Simulation of JK, MSJK flip-flops using Verilog code

Course outcomes (Course Skill Set):

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

CO1. Design and simulate basic CMOS circuits like different logic structures.

CO2: Design and simulate basic CMOS circuits like inverter, common source amplifier and Differential Amplifier.

CO3: Perform ASIC design flow and understand the process of synthesis, synthesis constraints and evaluating the synthesis reports to obtain optimum gate level net list.

CO4: Design and simulate combinational and sequential digital circuits using Verilog HDL.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

` **High-3, Medium-2, Low-1**

VI Semester

INTRODUCTION TO E-VEHICLES

Course Code:	22ECT607B	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	1:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	16	**Total Marks:**	100
Credits:	01	**Exam Hours:**	02

Course objectives:

1. To impart the knowledge of EV battery chargers.
2. To introduce advanced linear and state space methods for the control of electrified vehicles.
3. To provide a fundamental understanding of the various mechanical systems of a typical electric vehicle.
4. To provide a fundamental understanding of the Chassis and Steering System
5. To provide a fundamental understanding of the Controls for steering, braking, and suspension.

Module-1	**04 hrs**

Environmental Impact:

Air Pollution- Nitrogen Oxides, Carbon Monoxide, Unburned Hydrocarbons and Other Pollutants.
Global Warming, Petroleum Resources, Induced Costs,

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**03 hrs**

History of Modern Transportation: Importance of Different Transportation Development Strategies to Future Oil Supply, History of Electric Vehicles, History of Hybrid Electric Vehicles,History of Fuel Cell Vehicles. **Text1**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**03 hrs**

Electric Vehicles: Configurations of Electric Vehicles, Performance of Electric Vehicles- Traction Motor Characteristics, Tractive Effort and Transmission Requirement., Vehicle Performance. Tractive Effort in Normal Driving, Energy Consumption **Text1**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**03hrs**

Hybrid Electric Vehicles: Concept of Hybrid Electric Drive Trains, Architectures of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains **Text1**

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**03hrs**

Energy Storages: Electrochemical Batteries, Electrochemical Reactions, Thermodynamic Voltage, Specific Energy, Specific Power, Energy Efficiency, Battery Technologies. **Text1**

Teaching Learning Method:	Chalk and Talk, Power point presentations

RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Explain Environmental Impact
CO 2 - Discuss the Modern Transportation
CO 3 - Analyze the systems of a typical electric vehicle.
CO 4 - Illustrate the concepts of Hybrid Electric Vehicles
CO 5 - Describe Energy Storages

Suggested Learning Resources:

Text Books:

1.Ehsani, Mehrdad, et al. Modern electric, hybrid electric, and fuel cell vehicles. CRC press 2018

Reference Books:

1.Jazar, Reza N. Vehicle dynamics: theory and application. Springer 2017
2.Rajesh Rajamani, Vehicle Dynamics and Control, Springer 2012
3. Husain, Iqbal. Electric and hybrid vehicles: design fundamentals. CRC press 2010
4.Katsuhiko Ogata, Modern Control Engineering, PHI, Twelfth Edition 2014
5. Iqbal Husain, "Electric and Hybrid Vehicles: Design Fundamentals", CRC Press 202

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2			2								1	2	
CO2		2	3		3								1	2	
CO3	1	2	3										1	2	
CO4							1		2	3				2	
CO5				3			2	1							1

High-3, Medium-2, Low-1

Dr.Ambedkar Institute of Technology, Bengaluru-560056
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					Theory Lecture	Tutorial	Practical/ Drawing	Self Study	Duration hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	22ECU701	Digital communication and coding		3	0	2		03	50	50	100	4
2	IPCC	22ECU702	Computer Networks and Protocols		3	0	2		03	50	50	100	4
3	PCC	22ECT703	Wireless Communication Systems		3	2	0		03	50	50	100	4
4	PEC	22ECT704x	Professional Elective Course		3	0	0		03	50	50	100	3
5	OEC	22ECT705x	Open Elective Course		3	0	0		01	50	50	100	3
6	PROJ	22ECP706	Major Project Phase-II		0	0	12		03	100	100	200	6
										400	300	700	24

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **PEC**: Professional Elective Course, **OEC**: Open Elective Course PR: Project Work, **L:** Lecture, **T**: Tutorial, **P**: Practical S= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work

Professional Elective Course 22ECT704x

22ECT704A	**ASIC**	**22ECT704D**	**Analog and Mixed mode VLSI**
22ECT704B	**Intelligent Systems and Machine Learning Algorithms**	**22ECT704E**	**Cyber Security**
22ECT704C	**Operation Research**	**22 ECT704F**	**RF IC Design**

Open Elective Course 22ECT705x

22ECT705A	**E-waste Management**	**22ECT705D**	**Embedded Systems Applications**
22ECT705B	**Automative Electronics**	**22ECT705E**	**Cryptography**
22ECT705C	**Basic VLSI Design**		

Note: VII and VIII semesters of IV years of the program

(1) Institutions can swap the VII and VIII Semester Schemes of Teaching and Examinations to accommodate research internships/ industry internships after the VI semester**.**

(2)Credits earned for the courses of VII and VIII Semester Scheme of Teaching and Examinations shall be counted against the corresponding semesters whether the VII or VIII semesters is completed during the beginning of the IV year or the later part of IV years of the program.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of Engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10.

Open Elective Courses:

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PROJECT WORK (21XXP75): The objective of the Project work is

(i) To encourage independent learning and the innovative attitude of the students.

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(iii) To impart flexibility and adaptability.

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(v) To expand intellectual capacity, credibility, judgment and intuition.

(vi) To adhere to punctuality, setting and meeting deadlines. To install responsibilities to oneself and others.

(vii) To train students to present the topic of project work in a seminar without any fear, face the audience confidently, enhance communication skills, involve in group discussion to present and exchange ideas.

CIE procedure for Project Work:

(1) Single discipline: 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 evaluation of the project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

(2) Interdisciplinary: Continuous Internal Evaluation shall be group-wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable. The CIE marks awarded for the project work, shall be based on the evaluation of project work Report, project presentation skill, and question and answer session in the ratio 50:25:25. The marks awarded for the project report shall be the same for all the batch mates.

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					L	T	P	S					
1	PEC	22ECT801x	Professional Elective (Online Courses)		3	0	0		-	-	-	-	3
2	OEC	22ECT802x	Open Elective (Online Courses)		3	0	0		-	-	-	-	3
3	INT	22ECI803	Internship (Industry/Research) (14 - 20 Weeks)		0	0	12		03	100	100	200	10
										200	200	400	16

L: Lecture, **T**: Tutorial, **P**: Practical S= Self-Study, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **TD-** Teaching Department, **PSB**: Paper Setting department, **OEC**: Open Elective Course, **PEC**: Professional Elective Course. **PROJ**: Project work, **INT**: Industry Internship / Research Internship / Rural Internship.

Professional Elective Course (Online courses) 22ECT801x			
22ECT801A		22ECT801C	
22ECT801B		22ECT801D	
Open Elective Courses (Online Courses) 22ECT802x			
22ECT802A		22ECT802C	
22ECT802B		22ECT802D	

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Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize,appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

- With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their home town (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide.
  University/Institute shall not bear any cost involved in carrying out the internship by students. However, students can receive any financial assistance extended by the organization

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Elucidation:

At the beginning of IV years of the program i.e., after VI semester, VII semester classwork and VIII semester **Research Internship /Industrial Internship / Rural Internship** shall be permitted to be operated simultaneously by the University so that students have ample opportunity for an internship. In other words, a good percentage of the class shall attend VII semester classwork and a similar percentage of others shall attend to Research Internship or Industrial Internship or Rural Internship.

Research/Industrial /Rural Internship shall be carried out at an Industry, NGO, MSME, Innovation center, Incubation center, Start-up, center of Excellence (CoE), Study Centre established in the parent institute and /or at reputed research organizations/institutes.

The mandatory Research internship /Industry internship / Rural Internship is for 14 to 20 Weeks. The internship shall be considered as a head of passing and shall be considered for the award of a Degree. Those, who do not take up/complete the internship shall be declared to fail and shall have to complete it during the subsequent University examination after satisfying the internship requirements.

Research internship: A research internship is intended to offer the flavor of current research going on in the research field. It helps students get familiarized with the field and imparts the skill required for carrying out research.

Industry internship: Is an extended period of work experience undertaken by students to supplement their Degree for professional development. It also helps them learn to overcome unexpected obstacles and successfully navigate organizations, perspectives, and cultures. Dealing with contingencies helps students recognize,appreciate, and adapt to organizational realities by tempering their knowledge with practical constraints.

Rural Internship: Rural development internship is an initiative of Unnat Bharat Abhiyan Cell, RGIT in association with AICTE to involve students of all departments studying in different academic years for exploring various opportunities in techno-social fields, to connect and work with Rural India for their upliftment.

The faculty coordinator or mentor has to monitor the student's internship progress and interact with them to guide for the successful completion of the internship.The students are permitted to carry out the internship anywhere in India or abroad. University shall not bear any expenses incurred in respect of the internship.

- With the consent of the internal guide and Principal of the Institution, students shall be allowed to carry out the internship at their home town (**within or outside the state or abroad**), provided favorable facilities are available for the internship and the student remains regularly in contact with the internal guide.
  University/Institute shall not bear any cost involved in carrying out the internship by students. However, students can receive any financial assistance extended by the organization

VII Semester

DIGITAL COMMUNICATION AND CODING			
Course Code:	22ECU701	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S)	3: 0: 2: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. A brief overview of the digital communication system and the techniques detection and estimation.
2. To Understand information on discrete PAM signals, ISI for data transmission
3. To Understand and analyse different waveform coding techniques and applications and spread spectrum modulation
4. To impart the basic concepts of information theory
5. To be able to understand the concepts of source coding.

Module-1	**09 hrs**

DETECTION AND ESTIMATION: Introduction to communication system(Block Diagram), Gram-Schmidt Orthogonalization Procedure, geometric interpretation of signals, response of bank of correlators to noisy input, Detection of known signals in noise, probability of error, correlation receiver, matched filter receiver.

WAVEFORM CODING TECHNIQUES: Pulse Code Modulation, channel noise and error probability, Quantization noise and Signal to Noise Ratio, robust quantization, DPCM, DM

TEXT 1

Teaching Learning Method:	Chalk and talk method, Power Point Presentation.
RBT Level:	L1, L2, L3

Module-2	**07 hrs**

BASE-BAND SHAPING FOR DATA TRANSMISSION: Discrete PAM signals, power spectra of discrete PAM signals, Inter Symbol Interference, Nyquist's criterion for distortion less base-band binary transmission, eye pattern.

SPREAD SPECTRUM MODULATION: Principle of Direct Sequence Spread Spectrum (DSSS), frequency hop spread spectrum.

TEXT 1

Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

DIGITAL MODULATION TECHNIQUES: Digital Modulation formats. Coherent binary modulation techniques: Binary ASK, PSK, and FSK. Coherent Quadrature modulation techniques: Quadriphase-shift keying (QPSK). Non-coherent binary modulation techniques, Differential phase shift keying (DPSK).

TEXT 1 and TEXT 2

Teaching Learning Method:	Chalk and talk method, Power Point Presentation, YouTube videos.
RBT Level:	L1, L2, L3

Module-4	**09 hrs**

INFORMATION THEORY: Introduction, Measure of information, Average information content of symbols in long independent sequences, Average information content of symbols in long dependent sequences. Markoff statistical model for information source, Entropy and information rate of mark-off source.

SOURCE CODING: Encoding of the source output, Shannon's encoding algorithm, Source coding theorem, Huffman coding, Single error correction Hamming code. **(Only binary codes)** **TEXT 2 and TEXT 3**	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power Point Presentation, YouTube videos. L1, L2, L3

Module-5	**06 hrs**
INTRODUCTION TO ERROR CONTROL CODING: Introduction, Types of errors, examples, Types of codes, Linear Block Codes: Matrix description, Error detection and correction, Convolution Encoder. **TEXT 2 and TEXT 3**	
Teaching Learning Method: **RBT Level:**	Chalk and talk method, Power Point Presentation, YouTube videos. L1, L2, L3

PRACTICAL COMPONENT OF IPCC	
Sl.No.	**Hardware Experiments**
1	Generation and demodulation of the Amplitude Shift Keying signal.
2	Generation and demodulation of the Phase Shift Keying signal.
3	Generation and demodulation of the Frequency Shift Keying signal.
4	Generation of DPSK signal and detection of data using DPSK transmitter and receiver.
5	Generation and demodulation of the Quadrature Frequency Shift Keying signal.
Simulation Experiments (Using MATLAB software)	
6	Gram-Schmidt Orthogonalization: To find orthogonal basis vectors for the given set of vectors and plot the orthonormal vectors.
7	Simulation of binary baseband signals using a rectangular pulse and estimate the BER for AWGN channel using matched filter receiver.
8	Perform the DM, DPCM Modulation and demodulation.
9	Encoding and Decoding of binary data using a Hamming code.
10	Encoding and Decoding of Huffman code.
11	Encoding and Decoding of Linear Block Codes.
12	Encoding and Decoding of Convolution code

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand detection and estimation techniques and waveform coding methods like PCM, DPCM, and DM.

CO2. Identify the schemes for base-band shaping methods and explain spread spectrum modulation techniques.

CO3. Characterize th digital modulation schemes such as ASK, PSK, FSK, QPSK, and DPSK.

CO4. Interpret entropy, information rate, and apply Markov models in communication.

CO5. Illustrate source coding techniques and explain basic error control coding methods.

Suggested Learning Resources:

Text Books:

1. **Simon Haykins**, "Digital Communications", 4th Edition, John Wiley, 2008(reprint).

2. **K.Sam Shanmugam**, "Digital and analog communication systems",4th Edition, John Wiley, 1996.
3. **Simon Haykins**, "Communication systems", 4th Edition edition, John Wiley India Pvt. Ltd, 2008
4. **Dr. K. N. Hari Bhat & Dr. D. Ganesh Rao**, "Digital communications", 2nd Edition, Sanguine Technical publications, 2008. (Reprint).
5. **Bernard Sklar**," Digital communications", 3rd Edition, Pearson education, 2007

Reference Books:

1. **John Proakis, Masoud Salehi,**" Digital communications", 5th Edition, Mac Graw Hill, 2008.
2. **Glover and Grant, "**Digital Communications", 2nd , Pearson Ed, 2008
3. P.S Satyanarayana, "Information Theory and Coding", edition, Dyanaram Publications, Reprint 2001

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars
- Micro Projects can be given to improve the skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1					1	1	1		1	3	3	
CO2	3	2	1					1	1	1		1	3	3	
CO3	3	2	1					1	1	1		1	3	3	
CO4	3	2	1					1	1	1		1	3	3	
CO5	3	2	1					1	1	1		1	3	3	

High-3, Medium-2, Low-1

VII Semester

COMPUTER NETWORKS AND PROTOCOLS			
Course Code:	**22ECU702**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:2:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	04	**Exam Hours:**	03

Course objectives:

1. To introduce the fundamental concepts of data communication and network models, including components, types of networks, and layered architectures like TCP/IP and OSI
2. Understand the functioning of data link control mechanisms, media access control protocols, and the structure and behaviour of wired and wireless LANs.
3. To explore the services of the network layer, including routing, packet forwarding, IP addressing (IPv4 and IPv6), and network protocols.
4. To analyse the functionalities of transport layer protocols, with a focus on reliable data transfer, error control, and congestion management in TCP and UDP.
5. To understand the working of application layer protocols such as HTTP, FTP, DNS, and email, and their role in delivering services to end-users.

Module-1	**08 hrs**

Introduction: Data communication: Components, Data representation, Data flow, Networks: Network criteria, Physical Structures, Network types: LAN, WAN, Switching, The Internet.

Network Models: TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.

Data-Link Layer: Introduction: Nodes and Links, Services, Two Categories' of link, Sublayers, Link Layer addressing: Types of addresses, ARP.

Text 1 (1.1, 1.2, 1.3.1 to 1.3.4, 2.2, 2.3 ,9.1, 9.2.1, 9.2.2)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, You Tube Videos
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Data Link Control (DLC) services: Framing, Flow and Error Control. Media Access Control: Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. Connecting Devices: Hubs, Switches, Virtual LANs: Membership, Configuration, Communication between Switches, Advantages. Wired and Wireless LANs: Ethernet Protocol, Standard Ethernet. Introduction to wireless LAN: Architectural Comparison, Characteristics, Access Control.

Text 1 (11.1,12.1,13.1, 13.2.1 to 13.2.5,15.1,17.1,17.2)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, You Tube Videos
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Network Layer: Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses: Address Space, Classful Addressing, Classless Addressing, DHCP, Network Address Resolution Network Layer Protocols: Internet Protocol (IP): Datagram Format, Fragmentation, Options, Security of IPv4 Datagrams. IPv6 addressing and Protocol. Unicast Routing: Introduction, Routing Algorithms: Distance Vector Routing, Link State Routing, Path vector routing.

Text 1 (18.1(excluding 18.1.3), 18.2, 18.4,19.1,20.1, 20.2,22.1 and 22.2)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, GoBackN Protocol, Selective repeat protocol, Piggybacking Transport-Layer Protocols in the Internet: User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Error control, TCP congestion control.

Text1 (23.1, 23.2.1, 23.2.2, 23.2.3, 23.2.4, 23.2.5,24.2, 24.3.1, 24.3.2, 24.3.3, 24.3.4, 24.3.6, 24.3.8, 24.3.9)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, You Tube Videos
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client Server Protocols: Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. Quality of Service

Text1 (25.1, 26.1.2, 26.2, 26.3, 26.6, 30.1, 30.2.)

Teaching Learning Method:	Chalk and Talk, Powerpoint presentations, You Tube videos
RBT Level:	**RBT Level:** L1, L2, L3

PRACTICAL COMPONENT OF IPCC

Using suitable simulation software, demonstrate the operation of the following :

Sl. No.	**Simulation experiments using NS2/ NS3/ OPNET/ NCTUNS/ NetSim/ QualNet or any other equivalent tool**
1.	Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth
2.	Implement a four node point to point network with links n0-n2, n1-n2 and n2-n3. Apply TCP agent between n0-n3 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP
3.	Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.
4.	Implement Ethernet LAN using n nodes and assign multiple traffic to the nodes and obtain congestion window for different sources/ destinations
5.	Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.
6.	Implementation of Link state routing algorithm
	Implement the following using programming languages C/C++ etc,.
7.	Write a program for a HLDC frame to perform the following. i) Bit stuffing ii) Character stuffing.
8.	Write a program for distance vector algorithm to find suitable path for transmission
9.	Implement Dijkstra‘s algorithm to compute the shortest routing path
10.	For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases : i)with out error ii)with error
11.	Implementation of Stop and Wait Protocol and Sliding Window Protocol
12.	Write a program for congestion control using leaky bucket algorithm

Course outcomes:

At the end of the course the student will be able to:

CO1. Identify and explain the basic components of data communication systems and compare the OSI and TCP/IP reference models

CO2. Demonstrate knowledge of error detection, MAC protocols, and differentiate between wired and wireless LAN architectures.

CO3. Apply IP addressing schemes and explain routing algorithms used in network layer communication.

CO4. Compare TCP and UDP protocols and evaluate their performance in ensuring reliable end-to-end communication.

CO5. Explain the functions of application layer protocols and assess their impact on user-level network services and Quality of Service (QoS).

Text Book:

1. Data Communications and Networking, Forouzan, 5th Edition, McGraw Hill, 2016 ISBN: 1-25-906475-3

Reference Books:

1. A.S Tanenbaum - Computer Networks, 4th Edition, PHI, 2003
2. Computer Networks, James J Kurose, Keith W Ross, Pearson Education, 2013, ISBN: 0-273-76896-4
3. Introduction to Data Communication and Networking, Wayarles Tomasi, Pearson Education, 2007, ISBN:0130138282

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	3			2										
CO3	3	3	2		2										
CO4	3	2	2		2										
CO5	3	2	2		1										

High-3, Medium-2, Low-1

VII Semester

WIRELESS COMMUNICATION SYSTEMS			
Course Code:	**22ECT703**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:1	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand the concepts of signal propagation over wireless channels
2. Understand the system architecture and layers of LTE based on the use of OFDMA and SCFDMA principles.
3. Understand the multiple access techniques used in cellular communications standards.
4. Understand the design and coding of MIMO wireless systems.
5. Understand the LTE architecture, channel structure, protocol stack, and resource allocation in downlink OFDMA and uplink SC-FDMA.

Module-1	**08 hrs**

Principles of Wireless Communications: The Wireless Communication Environment, Modelling of wireless systems, System model for narrowband Signals, Rayleigh fading Wireless Channel.
The Wireless Channel: Basics of Wireless Channel Modelling, Average Delay Spread in Outdoor Cellular Channels, Coherence bandwidth, Relation between ISI and Coherence Bandwidth, Doppler fading, Doppler Impact on a wireless Channel, Coherence Time.
[Text1: 3.1 to 3.4, 4.1 to 4.7]

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Evolution of Cellular Technologies: First Generation Cellular Systems, 2G Digital cellular systems – GSM and its Evolution, 3G Broadband Wireless Systems, Key Enabling Technologies and features of LTE, LTE Network Architecture.
Frequency Domain Multiple Accesses: Multiple Access for OFDM Systems, Orthogonal Frequency Division Multiple Access, Single Carrier Frequency Division Multiple Access.
[Text2: 1.2.1, 1.2.1.1, 1.2.2, 1.2.2.1, 1.2.3 (Only the mentioned sections and subsections), 1.4, 1.5, 4.1, 4.2, 4.3]

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Code Division for Multiple Access (CDMA): Basic CDMA Mechanism, Fundamentals of CDMA codes, Spreading Codes based on PN sequences, Correlation Properties of Random CDMA Spreading Sequences, Advantages of CDMA.
Orthogonal Frequency Division Multiplexing (OFDM): Introduction, Motivation and Multicarrier basics, OFDM basics, OFDM Example, MIMO OFDM, OFDM Peak to Average Power ratio, SC-FDMA.
[Text1: 5.1 to 5.5, 5.7, 7.1, 7.2, 7.3, 7.5, 7.7, 7.8]

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Multiple Input Multiple Output Wireless Communications: Introduction to MIMO Communications, MIMO system Model, MIMO Zero Forcing Receiver, MIMO MMSE Receiver, Singular Value decomposition of MIMO Channel, SVD and MIMO capacity, Alamouti and Space-Time Codes, Nonlinear MIMO receiver: V-Blast, MIMO Beamforming.
[Text1:6.1,6.2, 6.3, 6.4, 6.5, 6.6, 6.8, 6.9, 6.10]

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

Overview and Channel Structure of LTE: Radio Interface Architecture, LTE Design principles, Network Architecture, Radio Interface Protocols, Hierarchical Structure of LTE: Logical Channels, transport Channels and Physical Channels, Channel mapping, Downlink OFDMA Radio resources, Physical Resource Blocks for OFDMA, Uplink SC-FDMA Radio resources.
[Text2: 6.1 to 6.4]

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Describe the wireless channel models for slow and fast fading environment.
CO2. Understand the system architecture and the functional standard specified in LTE 4G.
CO3. Understand the different multiple access technologies used in wireless communications.
CO4. Describe the of MIMO transmitter and receiver process using coding examples.
CO5. Describe the LTE architecture, channel structure, channel mapping, and radio resource allocation in downlink OFDMA and uplink SC-FDMA.

Suggested Learning Resources:

Text Book

Text 1. Aditya K Jagannatham, "Principles of Modern Wireless Communication systems, Theory and Practice ", Mc Graw Hill Education (India) Private Limited, 2017, ISBN 978-81- 265-4231-4.
Text 2. Arunabha Ghosh, Jun Zhang, Jeffrey G. Andrews, Rias Muhamed, "Fundamentals of LTE", Pearson India
Education Services Private Limited, 2018, ISBN: 978-93-530-6239-2.

Reference Books

1. T L Singal, "Wireless Communications", Mc Graw Hill Education (India) Private Limited, 2016, ISBN:978-0-07-068178-1
2. Theodore Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Prentice Hall Communications Engineering and Emerging Technologies Series, 2002, ISBN 0-13-042232-0.

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	3	2											2		
CO3	3	2	2										3	2	
CO4	3	2	3										3	3	2
CO5	3	2	2										3	2	2

High-3, Medium-2, Low-1

VII Semester

ASIC DESIGN			
Course Code:	22ECT704A	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:3	04	**Exam Hours:**	3

Course objectives:

1. Analysis of ASIC design flow.
2. Describe the concepts of ASIC design methodology, data path elements, logical effort
3. Analyze back-end physical design flow, including partitioning
4. Analyze back-end physical design flow, including floor planning and placement,
5. Analyze back-end physical design flow, includes routing.

Module-1

Introduction To ASICs: Types of ASICs, Full-Custom ASICs, Standard cell based ASICs, Gate array based ASICs, Channelled gate array, channel-less gate array, structured gate array, Programmable logic devices (PLD), Field– programmable gate arrays (FPGA),ASIC Design flow, ASIC Cell Libraries **(Text 1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1,L2, L3

Module-2

CMOS Logic: Datapath Logic Cells: Datapath Elements, Adders: Carry Skip, Carry Bypass, Carry Save, Carry Select, Conditional Sum. Multiplier (Booth Encoding), Data Path Operators, I/O Cells. [TEXT1]

ASIC Library Design: Logical Effort: Predicting Delay, Logical Area and Logical Efficiency, Logical Paths, Multi Stage Cells, Optimum Delay and Number of Stages. **(Text 1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1,L2, L3

Module-3

Low-Level Design Entry: Schematic Entry: Hierarchical Design, Netlist Screener. ASIC Construction: Physical Design, CAD Tools.

Partitioning: Goals and Objectives, Constructive Partitioning, Iterative Partitioning Improvement. KL Algorithms. (**TEXT1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1,L2, L3

Module-4

Floor Planning and Placement: Goals and Objectives, Floor Planning Tools, Channel Definition, I/O And Power Planning and Clock Planning.

Placement: Goals and Objectives, Min-Cut Placement Algorithm, Iterative Placement Improvement, Physical Design Flow. (**TEXT1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1,L2, L3

Module-5

Routing: Global Routing: Goals and Objectives, Global Routing Methods, Back-Annotation. Detailed Routing: Goals and Objectives, Measurement of Channel Density, Left-Edge and Area-Routing Algorithms. Special Routing, Circuit Extraction and DRC. (**TEXT1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1,L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1: Analysis of ASIC design flow.

CO2: Describe the concepts of ASIC design methodology, data path elements, logical effort

CO3: Analyze back-end physical design flow, including partitioning

CO4: Analyze back-end physical design flow, including floor planning and placement,

CO5: Analyze back-end physical design flow, includes routing.

Suggested Learning Resources:

Text Books:

1. Michael John Sebastian Smith, "Application - Specific Integrated Circuits" Addison Wesley Professional; 2005.
2. Neil H.E. Weste, David Harris, and Ayan Banerjee, "CMOS VLSI Design: A Circuits and Systems Perspective" , Addison Wesley/ Pearson education 3rdedition, 2011

Reference Book:

1. Vikram Arkalgud Chandrasetty, "VLSI Design: A Practical Guide for FPGA and ASIC Implementations" Springer, ISBN: 978-1-4614-1119-2. 2011

Web Links: http://nptel.ac.in

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2									1	1	1
CO2	3	3	2	2	2								1	1	1
CO3	3	2	1		2								1	1	1
CO4	3	2	2										1	1	1
CO5	2	2	3										1	1	1

High-3, Medium-2, Low-1

VII Semester

INTELLIGENT SYSTEMS AND MACHINE LEARNING ALGORITHMS			
Course Code:	22ECT704B	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Gain a historical perspective of AI and its foundations.
2. Become familiar with basic principles of AI toward Problem-Solving
3. Get to know approaches of inference, perception, knowledge representation, and learning
4. Define Machine Learning and understand the basic theory underlying machine learning.
5. Differentiate supervised, unsupervised, and reinforcement learning

Module-1	**08 hrs**
Introduction: Acting humanly: The Turing Test approach, Thinking humanly: The cognitive modeling approach, Thinking rationally: The "laws of thought" approach, Acting rationally: The rational agent approach, Foundations and History of AI. **Intelligent Agents:** Agents and environment, Concept of Rationality, The nature of environment, The structure of agents. Text book 1: Chapter 1- 1.1, 1.2, 1.3 Chapter 2- 2.1, 2.2, 2.3, 2.4	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**
Problem-solving: Problem-solving agents, Example problems, Searching for Solutions **Uninformed Search Strategies:** Breadth First search, Depth First Search, Iterative deepening depth first search; Text book 1: Chapter 3- 3.1, 3.2, 3.3, 3.4	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
Informed Search Strategies: Heuristic functions, Greedy best first search, A*search. Heuristic Functions Logical Agents: Knowledge–based agents, The Wumpus world, Logic, Propositional logic, Reasoning patterns in Propositional Logic Text book 1: Chapter 4- 4.1, Chapter 7	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**
Introduction: Machine learning Landscape: About ML, Types of ML, main challenges of ML Concept learning and Learning Problems – Designing Learning systems, Perspectives and Issues – Concept Learning – Find S-Version Spaces and Candidate Elimination Algorithm – Remarks on VS-Inductive bias. Text book 3: Chapter 1, Textbook 4:Chapter 1 and 2	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

End-to-end Machine learning Project: Working with real data, Look at the big picture, Get the data, Discover and visualize the data, Prepare the data, select and train the model, Fine tune your model. Classification: MNIST, training a Binary classifier, performance measure, multiclass classification, error analysis, multi-label classification, multi-output classification

Textbook 4: Chapter 2, Chapter 3

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Apply knowledge of agent architecture, searching, and reasoning techniques for different Applications.

CO 2. Compare various Searching and Inferencing Techniques.

CO 3. Develop knowledge base sentences using propositional logic and first-order logic

CO 4. Understand the concept of Machine Learning and Concept Learning.

CO 5. Apply the concept of ML and various classification methods in a project

Suggested Learning Resources:

Text Book:

1. Stuart J. Russell and Peter Norvig , Artificial Intelligence, 3rd Edition, Pearson,2015

2. Elaine Rich, Kevin Knight, Artificial Intelligence, 3rd Edition,Tata McGraw Hill,2013.

3. Tom M. Mitchell, Machine Learning, McGraw-Hill Education, 2013

4. Aurelien Geron, Hands-on Machine Learning with Scikit-Learn &Tensor Flow , O'Reilly, Shroff Publishers and Distributors Pvt. Ltd 2019.

Reference Books:

1. George F Lugar, Artificial Intelligence Structure and strategies for complex, Pearson Education, 5th Edition, 2011

2. Nils J. Nilsson, Principles of Artificial Intelligence, Elsevier, 1980

3. Saroj Kaushik, Artificial Intelligence, Cengage learning, 2014.

4. Ethem Alpaydin, Introduction to Machine Learning, PHI Learning Pvt. Ltd, 2nd Ed., 2013

5. T. Hastie, R. Tibshirani, J. H. Friedman, The Elements of Statistical Learning, Springer, 1st edition, 2001

6. Machine Learning using Python, Manaranjan Pradhan, U Dinesh Kumar, Wiley, 2019

7. Machine Learning, Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Pearson,2020

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					2									
CO2	1												1		
CO3			3										1		
CO4	3														
CO5											2				1

High-3, Medium-2, Low-1

VII semester

OPERATIONS RESEARCH			
Course Code:	**22ECT704C**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3 : 0 : 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	39	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives: This course will enable students to:

1. Understand the Scope of Operations Research and TP Formulation.
2 Understand the Assignment Problem.
3. Understand the Network Construction.
4. Understand the competitive real-world phenomena using concepts from game theory.
5. Formulate Queuing models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Queuing problems.

Module-1	**08 hrs**

Introduction to Operations Research: Basics definition, Scope, Objectives, Phases, Models and Limitations of Operations Research.

Transportation Problem: Formulation, Solution, Unbalanced Transportation problem. Finding basic feasible solutions – Northwest corner rule, least cost method and Vogel's approximation method. Optimality test.Text1

Teaching Learning Method:	Chalk & Board, PowerPoint
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Assignment model: Formulation. Hungarian method for optimal solution. Solving unbalanced problem. Traveling salesman problem and assignment problem. **Text1**

Teaching Learning Method:	Chalk & Board, PowerPoint
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

PERT-CPM Techniques: Network construction, determining critical path, floats, scheduling by network, project duration, variance under probabilistic models, prediction of date of completion, crashing of simple networks. **Text1**

Teaching Learning Method:	Chalk & Board, PowerPoint
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Game Theory: Formulation of games, two person-Zero sum game, games with and without saddle point, Graphical solution (2x n, m x 2 game). **Text1**

Teaching Learning Method:	Chalk & Board, PowerPoint
RBT Level:	L1, L2, L3

Module-5	**07 hrs**

Queuing Theory: Queuing system and their characteristics. The M/M/1 Queuing system, Steady state performance analyzing of M/M/ 1 and M/M/C queuing model. **Text1**

Teaching Learning Method:	Chalk & Board, PowerPoint
RBT Level:	L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Determine the optimal solution for Transportation problems.

CO2. Ability to interpret and explain the Assignment Problem.

CO3. Formulate and solve problems as networks and graphs.

CO4. Determine the best strategy and value of the given game model.

CO5. Design the Queuing system, Game Theory and their characteristics.

Suggested Learning Resources: Text

Books:

1: P. Sankara Iyer, "**Operations Research**", First Edition, Tata McGraw-Hill, ***2008***

2: A.M. Natarajan, P. Balasubramani, A. Tamilarasi, "**Operations Research**", First Edition, Pearson Education, ***2005***

Reference Books (if required)

1: P. K. Gupta and D. S. Hira, "**Operations Research**", Second Edition, S. Chand & co, ***2007***

2: S D Sharma, "**Operations Research, Problems and Solutions**", Paperback 1, kedar Nath Publisher, India Ltd, ***2012***

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning Activity

1:

Activity 2:

Activity 3:

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2						1	1			3	1	
CO2	3	2	2						1	1			3	1	
CO3	3	2	2						1	1			3	1	
CO4	3	2	2						1	1			3	1	
CO5	3	2	2						1	1			3	1	

High-3, Medium-2, Low-1

VII Semester

ANALOG AND MIXED MODE VLSI CIRCUITS			
Course Code:	22ECT704D	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	3

Course objectives:

1. Understand the concept of Analog Design.
2. Analysis of Single stage amplifiers in VLSI perspective.
3. Analysis of Current sources and sinks in VLSI perspective.
4. Understand the concept of Data Converter Fundamentals.
5. Design and Mismatch Error Analysis of DAC and ADC Architectures.

Module-1

Basic MOS Device Physics: General considerations: MOSFET as a Switch, MOSFET Structure, MOS symbols, MOS I/V Characteristics: Threshold Voltage, Derivation of I/V Characteristics, Second Order Effects, MOS Device Models: MOS Device Layout, capacitances, MOS Small-signal Model **(Text 1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L2

Module-2

Single Stage Amplifiers: Basic Concepts, Common source stage, Common Source stage with resistive load, Common Source stage with Diode connected load, Common Source Stage with Current Source load, Common Source stage with Triode load, Common Source stage with source degeneration. **(Text 1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L2,L3

Module-3

Single stage Amplifier: Common-gate stage, Cascode Stage, choice of device models. **(Text 1)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L2,L3

Module-4

Current Sources and Sinks: The current mirror, The Cascade Connection, Sensitivity Analysis, Transient response, other current sources & sinks. **(Text 1, 2)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation

RBT Level:	L2,L3

Module-5

Data Converter Architectures: DAC architecture, Digital input code, Resistors string, R-2R ladder networks, Charge scaling DACs, Cyclic DAC, Pipeline DAC.
ADC Architecture: Flash, 2-step flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC. **(Text 2)**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L3,L4

Course outcomes:
At the end of the course the student will be able to:

CO1. Draw the basic gates using the stick and layout diagrams with the knowledge of physical design aspects.
CO2. Ability to Analyse and Design of Single Stage Amplifiers.
CO3. Ability to Analyse and Design of Current sources and sinks.
CO4. Understand concepts of ADC and DAC
CO5. Analysis of ADC, DAC Architectures and Mismatch errors.

Assessment Details (both CIE and SEE):
Note 1.Unit 1, 2, 3, 4 and Unit 5 will have internal choice.
Note 2.Two assignments are evaluated for 5 marks: Assignment – 1 from units 1 and 2 Assignment - 2 from units 3, 4 and 5.

Suggested Learning Resources:
Text Books:
1: Behzad Razavi, "Design of Analog CMOS Integrated Circuits", Twenty Fifth Reprint, TATA McGraw Hill, 2013.
2: R Jacob Baker, "CMOS Circuit Design, Layout and Simulation", PHI, 2005.
Reference Books
1: Philip E Allen and Douglas R Holberg, "CMOS Analog Circuit Design", Second edition, Oxford University Press, 2004.
2: Adel Sedra and K C Smith, "Microelectronics Circuits", Fifth edition, Oxford University Press, 2009.
Web Links: http://nptel.ac.in

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3									1	1	1
CO2	3	3	2	3	2								1	1	1
CO3	3	2	1		2								1	1	1
CO4	3	3	2										1	1	1
CO5	3	2	3										1	1	1

High-3, Medium-2, Low-1

VII Semester

CYBER SECURITY			
Course Code:	**22ECT704E**	**CIE Marks:**	40+5+5
Teaching Hours/Week (L:T:P:S):	3: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	3	**Exam Hours:**	03

Course objectives:

This course will enable the students to:

1. Familiarize various types of cyber-attacks and cyber-crimes
2. Give an overview of the cyber laws
3. Study the defensive techniques against these attacks
4. Study cyber security challenges and implications.

Module-1	**08 hrs**
Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIATriad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defence, Security Models, risk management, Cyber Threats- Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.	
Teaching Learning Method: Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3	
Module-2	**08 hrs**
Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.	
Teaching Learning Method: Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3	
Module-3	**08 hrs**
Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.	
Teaching Learning Method: Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. **RBT Level:** L1, L2, L3	
Module-4	**08 hrs**
Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.	

Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cybercriminals.

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L

Module-5	**08 hrs**

Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy indifferent domains- medical, financial etc.

Cybercrime: Examples and Mini-Cases

Examples: Official Website of Maharashtra Government Hacked, Indian Banks Lose Millions of Rupees, Parliament Attack, Pune City Police Bust Nigerian Racket, e-mail spoofing instances.

Mini-Cases: The Indian Case of online Gambling, An Indian Case of Intellectual Property Crime, Financial Frauds in Cyber Domain.

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Course outcomes:

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

1. Understand basic concepts of Cyber Crimes.
2. Ability to identify the attacks in Cyber Crimes
3. Able to specify the suitable methods used in Cyber Crime
4. Ability to face cyber security challenges
5. Understand Cyber laws

Suggested Learning Resources:

Text Books:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley, 2011.

2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.

REFERENCE BOOKS:

1. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson, CRC Press.

2. Introduction to Cyber Security, Chwan-Hwa (john) Wu, J. David Irwin, CRC Press T&F Group

Weblink:

https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			3		2							2	2	
CO2		2	3					1					2		3
CO3		1	2		3								2	2	
CO4		1		2		3							2		
CO5		1	2		3								2		3

High-3, Medium-2, Low-1

VII Semester

RF IC DESIGN			
Course Code:	**22ECT704F**	**CIE Marks:**	40+5+5
Teaching Hours/Week (L:T:P:S):	3: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	3	**Exam Hours:**	03

Course objectives:

This course will enable the students to:

understand passive components at RF frequencies and required circuit theory
design high frequency amplifiers and low noise amplifiers
carryout comparison different types of mixers
perform analysis of oscillators and synthesizers at RF frequencies

Module-1	**08 hrs**

Characteristics of passive IC components at RF frequencies:
Interconnects, resistors, capacitors, inductors and transformers – Transmission lines Classical two-port noise theory, noise models for active and passive components, Noise figure, Nonlinearity, cascaded stages, Sensitivity and dynamic range

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

High frequency amplifier design – zeros as bandwidth enhancers, shunt-series amplifier, f_T doublers, Low noise amplifier design – LNA topologies, impedance matching, power constrained noise optimization, linearity and large signal performance

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Mixers – fundamentals of mixers, multiplier-based mixers, sub sampling mixers, diode-ring mixers.

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Oscillators– Feedback View of Oscillators, Colpitts oscillator, Hartley oscillator, describing functions, tuned oscillators, negative resistance oscillators.

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L

Module-5	**08 hrs**

Synthesizers: Basic Integer-N Synthesizer, synthesis with static moduli, combination synthesizers, phases noise considerations.

Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Course outcomes:

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

CO1 Understand passive components at RF frequencies and required circuit theory
CO2 Design high frequency amplifiers and low noise amplifiers

CO3 Compare different types of mixers
CO4 Analyse oscillators and synthesizers at RF frequencies

Suggested Learning Resources:

Textbooks

1. Thomas H. Lee, Cambridge, The Design of CMOS Radio-Frequency Integrated Circuits, UK: Cambridge University Press, 2004
2. Phillip E. Allen and Douglas R. Holberg- CMOS Analog Circuit Design Oxford University Press -3rd Ed., -20

Reference Books

3. Behzad Razavi, RF Microelectronics, Prentice Hall, 1998.
4. Ludwig, RF Circuit Design, 2nd Ed., Pearson

e-Resources

1. https://nptel.ac.in/courses/117102012
2. https://archive.nptel.ac.in/courses/117/102/117102012/
3. https://www.digimat.in/nptel/courses/video/117102012/L17.html

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			3		2							2	2	
CO2		2	3					1					2		3
CO3		1	2		3								2	2	
CO4		1		2		3							2		
CO5		1	2		3								2		3

High-3, Medium-2, Low-1

VII Semester

E-WASTE MANAGEMENT			
Course Code:	**22ECT705A**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:1	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. **Understanding e-waste**: To learn about e-waste, its different types, and how it's generated
2. **E-waste rules and directives**: To understand the rules and directives for e-waste in different countries
3. **E-waste management**: To learn how to manage e-waste throughout its life cycle
4. **Environmental and health impacts**: To understand the environmental and health impacts of e-waste

Module-1	**08 hrs**
Introduction: Preamble, What is e-waste, E-waste Sources and generation, Growth of Electrical and Electronics Industry in India, Global Context of e-waste Management, Indian Scenario on e-waste Management, **E-WASTE:** E-waste Definition, Classification of e-waste, Characterization of e-waste Text 1: Chapter 1 & 2	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-2	**08 hrs**
Regulatory Framework: Global e-waste Regulations, Waste Electronics and Electrical Equipment (WEEE Directive 82), International norms – Basel Convention, Evolution of e-waste regulations in India, E-waste Management Rules 2016 (amendments to 2011 Rules), Regulatory Compliance Mechanisms, E-waste Management Guidelines (Text 1: 3.1 to 3.7)	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3
Module-3	**08 hrs**
Extended Producer Responsibility (EPR): E-waste – A post Consumer Waste, E-waste value Chain, E-waste Collection Systems, Extended Producer Responsibility (EPR), Collective Responsibility, Producer Responsible Organization (PRO) (Text 2: 4.1 to 4.6)	
Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3
Module-4	**08 hrs**
E-Waste Handling: Characterization & Classification, Packaging and Labelling, Transportation, Storage, Safety in Handling – Precautionary Principles: Text 1- Chapter 5	
Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3
Module-5	**08 hrs**
Restrictions on Use of Hazardous Substances (ROHS): Hazardous substances in e-waste, Global ROHS compliances (ROHS Directive 84), ROHS compliance requirements in India: Text 1: Chapter 6	

E-Waste Recycling: E-waste Recycling Operations, Dismantling & Segregation, Recycling & Recovery, Recycling Technologies – Text 1: Chapter 7 (7.1 to 7.4)

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1. Understand the environmental impacts of e-waste
CO2. Distinguish the role of various national and internal act and laws applicable for e-waste management and handling
CO3. Analyse the e-waste handling methods & restrictions
CO4. Analyze the e-waste recycling techniques

Suggested Learning Resources:

Text Books:

Lakshmi Raghupathy, Introduction to E-Waste Management, TERI Press, New Delhi.

Reference Books:

Johri R., E-waste: implications, regulations, and management in India and current global best practices, TERI Press, New Delhi

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

High-3, Medium-2, Low-1

VII Semester

AUTOMOTIVE ELECTRONICS			
Course Code:	**22ECT705B**	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0:1	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand the basics of automobile dynamics and design electronics to complement those features
2. Design and implement the electronics that attribute the reliability, safety, and smartness to automobile, providing add – on comforts

Module-1	**08 hrs**

Automotive Fundamentals Overview – Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive systems, The Engine- Engine Block, Cylinder Head, four stroke Cycle, Engine Control, Ignition System- Spark plug, High voltage circuit and distribution, spark pulse generation, ignition timing, diesel engine, Drive Train – Transmission, drive shaft, differential, suspension, brakes, steering system, starter battery operating principle. (Text1: Chapter1, Text 2: Pg. 407-410)

The Basics of Electronic Engine Control - Motivation for Electronic Engine, control – exhaust emissions, fuel economy, concept of an electronic engine, control system, definition of general terms, definition of engine performance terms, engine mapping, effect of air/fuel ration, spark timing and EGR on performance, control strategy, electronic fuel control system, analysis of intake manifold pressure, electronic ignition. (Text1: Chapter 5)

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Automotive Sensors – Automotive control system applications of sensors and Actuators – Variables to be measured, airflow rate sensor, strain gauge MAP sensor, Hall Effect position sensor, Magnetic Reluctance Crankshaft position sensor, Throttle angle sensor, Engine coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2 /EGO) Lambda sensors, piezoelectric Knock sensor **(Text 1: Chapter 6)**

Automotive Engine Control Actuators – Solenide, Fuel Injector, EGR actuator, Ignition system **(Text 1: Chapter 6)**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Digital Engine Control System- Digital Engine control features, Control modes for fuel control (Seven Modes), EGR Control, Electronic Ignition control- closed loop ignition timing, spark advance correction scheme, Integrated engine control system- secondary air management, Evaporative Emissions, Canister Purge, automatic system adjustment, system diagnostics **(Text 1: Chapter 7)**

Control Units – Operating conditions, Design, Data Processing, Programming, Digital modules in the Control Unit, Control Unit Software **(Text 2: Pg. 196-207)**

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Automotive Networking – Bus Stem- classification, Applications in the Vehicle, Coupling of networks, Examples of Networked Vehicles **(Text 2: Pg. 85-91),**
Buses – CAN Bus, LIN Bus, MOST Bus, Bluetooth, Flex Ray, Diagnostic Interfaces **(Text 2: Pg. 92-151)**
Vehicle Motion Control – Typical Cruise control system, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Cruse Control Configuration

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	L1, L2, L3

Module-5	**08 hrs**

Automotive Diagnostics – Timing Light, Engine Analyzer, On-Board diagnostics, Off-Board diagnostics, Expert Systems, Occupant Protection Systems – Accelerometer based Air Bag Systems (Text1: Chapter10)
Future Automotive Electronic Systems – Alternative Fuel Engines, Electric and Hybrid Vehicles, Fuel Cell Power Cars, Collision Avoidance Radar Warning Systems, Low tire pressure warning systems, Head Up Display, Speech Synthesis, Navigation- Navigation Sensors – Radio Navigation, Signpost Navigation, Dead reckoning navigation, Voice Recognition Cell phone Dialing, Advanced Cruise Control, Stability Augmentation, Automatic Driving Control (Text 1: Chapter 11)

Teaching Learning Method:	Chalk and Talk, Power point presentations
RBT Level:	**RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO1- Describe the basics of Automobile dynamics and design electronics.
CO2- Acquire an overview of automotive components, subsystems and basics of Electronic Engine Control in today's automotive industry.
CO3-Use available automotive sensors and actuators while interfacing with microcontrollers/microprocessors during automotive system design.

Suggested Learning Resources:

Text Books:

1. William B Ribbens, "Understanding Automotive Electronics", 6th Edition, Elsevier Publishing.
2. Robert Bosch GmbH (Ed.), "Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive", 5th edition, John Wiley & Sons Inc., 2007.

Reference Books:

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															
CO5															

High-3, Medium-2, Low-1

VII Semester

BASIC VLSI DESIGN			
Course Code:	22ECT705C	**CIE Marks:**	50
Teaching Hours/Week (L:T:P:S):	3:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	**03**	**Exam Hours:**	3

Course objectives:

1. Impart knowledge of MOS transistor theory and CMOS technologies
2. Learn the operation principles and analysis of inverter circuits, Understand basic circuit concepts and scaling of MOS circuits.
3. Representation of different forms of diagrams like layout & stick diagram.
4. Different CMOS logic structures
5. Analyze adder & multiplier circuits, Design Combinational,

Module-1

MOS Transistor: Enhancement and Depletion mode MOS transistors, Basic DC equations, second order effects: Threshold Voltage-Body Effect, Subthreshold region, channel length modulation, Mobility variation, Fowler Northeim Tunnelling, Drain Punch Through, Impact Ionization.
DC Transfer Characteristics: Static CMOS Inverter DC Characteristics, Beta Ratio Effect. Noise margin.

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2

Basic Circuit Concepts: Sheet resistance, Area capacitances, Capacitance calculations, The delay unit, Inverter delays.
Scaling of MOS Circuits: Scaling models and scaling factors, Scaling factors for device parameters, Limitations of scaling. **TEXT 1**

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3

CMOS Logic Structures: CMOS Complementary Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic, BiCMOS logic, Cascaded Voltage Switch Logic (CVSL).

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-4

Data Path Subsystems I:Introduction, addition/subtraction, single bit addition, carry propagate addition, carry ripple adder, carry generation & propagation, Manchester carry chain adder, carry skip Adder, carry look ahead adder, carry select, conditional sum adders, adder variants.

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation

RBT Level:	L1, L2, L3

Module-5

Data Path Subsystems II: Multiplication, unsigned array multiplication, 2's complement array multiplication, Booth encoding, Wallace tree multiplication

Teaching Learning Method:	Chalk and talk method , PowerPoint Presentation
RBT Level:	L1, L2, L3

Course outcomes:

Course outcome (Course Skill Set) At the end of the course the student will be able to:

CO1. Outline the basics of VLSI technology

CO2. Explanation of circuit design process and MOS transistor theory.

CO3. Analysis of component parameters.

CO4. Describe different logic structures.

CO5. Design of Arithmetic circuits using MOS transistors.

Suggested Learning Resources:

Text Books:

1. Douglas A. Pucknell& Kamran Eshraghian, "Basic VLSI Design", Third Edition, PHI, 2005

2. Neil H. E. Weste, K. Eshragian, "Principles of CMOS VLSI Design - A Systems Perspective", Second edition, Pearson Education (Asia) Pvt. Ltd, year.

3. Neil H.E Weste, David Harris, Ayan Banerjee, "CMOS VLSI design- A circuits and systems perspective", Third edition Pearson Education (Asia) Pvt. Ltd, 2006.

Reference Text Books.

1 R. Jacob Baker, "CMOS Circuit Design, Layout and Simulation", edition, John Wiley India Pvt. Ltd,

2 Sung- Mo Kang & Yusuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design", Third edition, Tata McGraw-Hill Publishing Company Ltd, 2007

Web Links: http://nptel.ac.in

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2									1	1	1
CO2	3	2	2	2	2								1	1	1
CO3	3	2	1		2								1	1	1
CO4	3	2	2										1	1	1
CO5	3	2	2										1	1	1

High-3, Medium-2, Low-1

VII Semester

EMBEDDED SYSTEMS APPLICATIONS			
Course Code:	22ECT705D	**CIE Marks:**	50
Teaching Hours/Week (L: T:P:S):	3:0:0:0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	03	**Exam Hours:**	03

Course objectives:

1. Understand the fundamental concepts, characteristics, and applications of embedded systems across various domains.
2. Analyse the hardware components of embedded systems, including microcontrollers, memory, and low-power design techniques.
3. Explore the role of sensors, ADCs, and actuators in embedded systems, and their interfacing with digital systems.
4. Apply embedded systems design principles in real-world applications such as mobile phones, automotive electronics, RFID, and biomedical systems.
5. Understand the embedded systems design and development process.

Module-1	**08 hrs**

Introduction to embedded systems: Application domain of embedded systems, desirable features and general characteristics of embedded systems, model of an embedded system, microprocessor Vs microcontroller, example of a simple embedded system, figure of merit for an embedded system, classification of MCUs: 4/8/16/32 bits, current trends.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-2	**08 hrs**

Embedded systems-The hardware point of view: Microcontroller unit (MCU), The Processor, The Harvard Architecture, A popular 8-bit MCU: General Purpose I/O (GPIO), Clock; Memory for embedded systems: Random Access Memory (RAM), Static RAM (SRAM), Dynamic RAM (DRAM). ROM (Read Only Memory) types, Caches.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation
RBT Level:	L1, L2, L3

Module-3	**08 hrs**

Sensors, ADCs and Actuators Sensors: Temperature Sensor, Light Sensor, Proximity/range Sensor; Analog to digital converters: ADC Interfacing, Control Interface, Data Interface; Actuators: Displays, Light Emitting Diodes (LED), Seven Segment LED; Motors: Stepper Motors, DC Motors.

Text 1

Teaching Learning Method:	Chalk and Talk, PowerPoint Presentation, YouTube videos
RBT Level:	L1, L2, L3

Module-4	**08 hrs**

Examples of embedded systems: Mobile phone: Block Diagram, Automotive electronics: Anti-lock Braking System (ABS), Airbag Deployment, Automotive Navigation Systems, Radio Frequency Identification (RFID), Wireless Sensor Networks (WISENET), Robotics, Biomedical applications, Brain machine interface: Block Diagram.

Text 1	
Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations L1, L2, L3

Module-5	08 hrs

Embedded Design-A Systems Perspective: A Typical Example, Product Design, The Design Process, Testing, Bulk Manufacturing.

Text 1

Teaching Learning Method: **RBT Level:**	Chalk and Talk, Power point presentations **RBT Level:** L1, L2, L3

Course outcomes:

At the end of the course the student will be able to:

CO 1 - Understand the fundamental concepts and characteristics of embedded systems, including their classification and modern trends.

CO 2 - Analyse the architecture and hardware components of MCUs and their role in embedded systems.

CO 3 - Apply knowledge of sensors, ADCs, and actuators for interfacing and control in embedded systems.

CO 4 - Evaluate real-world embedded system applications such as mobile phones, automotive electronics, RFID, and robotics.

CO 5 - Develop an understanding of the embedded design process, from concept to bulk manufacturing, including testing and product design.

Suggested Learning Resources:

Text Books:

1. Das, LyLa B.. Embedded Systems: An Integrated Approach. India: Pearson Education India, ISBN 9788131787663, 2013.

Reference books, Web links and Video Lectures (e-Resources):

1. Embedded Systems: https://nptel.ac.in/courses/108102045.
2. Embedded Systems Design: https://onlinecourses.nptel.ac.in/noc20_cs14/preview.
3. Shibu K V, "Introduction to Embedded Systems", Tata McGraw Hill Education Private Limited, 2nd Edition.
4. Android Mobile Application Development: https://onlinecourses.swayam2.ac.in/nou24_ge66/preview

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3				1										
CO2	3	2	2	1	2										
CO3	3	2		1	1										
CO4	3	2	2	1	2										
CO5	3	2	2	1	2				2		2				

High-3, Medium-2, Low-1

VII Semester

CRYPTOGRAPHY			
Course Code:	**22ECT705E**	**CIE Marks:**	40+5+5
Teaching Hours/Week (L:T:P:S):	3: 0: 0	**SEE Marks:**	50
Total Hours of Pedagogy:	40	**Total Marks:**	100
Credits:	3	**Exam Hours:**	03

Course objectives:

This course will enable the students:

1. To impart the basic concepts of network security and classical encryption, number theory, stream ciphers, block ciphers and authentication
2. To interpret the cryptographic algorithms like stream ciphers and block ciphers using classical encryption techniques
3. To apply the concept of classical encryption techniques to stream ciphers and block ciphers
4. To analyse the stream ciphers, block ciphers and authentication functions
5. To design the stream ciphers, block ciphers and authentication functions

Module-1	**08 hrs**
Introduction: Services, mechanisms and attacks, OSI security architecture, Model for network security. Symmetric ciphers: Symmetric Cipher Model, Substitution Techniques: Caesar Cipher, Mono Alphabetic Cipher, Playfair Cipher, Hill Cipher, polyalphabetic Cipher and One-Time Pad (OTP). Transposition Techniques, Rotor Machines, Steganography. **TEXT 1**	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2

Module-2	**08 hrs**
Finite Fields: Groups, Rings, Fields. Modular Arithmetic: Divisors, properties of modulo operator, modular arithmetic operations and properties. Euclid's Algorithm, Greatest Common Divisor (GCD), finding GCD. Finite Fields of the form GF (p): Finite fields of order p, polynomial arithmetic. **TEXT 1**	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Module-3	**08 hrs**
Private Key Encryption: Simplified DES, Block Cipher Principles, Data encryption standard (DES), Strength of DES, Block Cipher Design Principles and Block Cipher Modes of Operation, Evaluation Criteria for Advanced Encryption Standard, The AES Cipher. **TEXT 1**	
Teaching Learning Method:	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs.
RBT Level:	L1, L2, L3

Module-4	**08 hrs**
Public Key Encryption: Principles of Public-Key Cryptosystems, The RSA algorithm. Key Management, Diffie - Hellman Key Exchange. **TEXT 1**	

Teaching Learning Method: **RBT Level:**	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. L1, L2

Module-5	**08 hrs**

Authentication Functions and Hash Functions: Authentication functions, message authentication codes, hash functions, security of Hash functions and MACs.

TEXT 1

Teaching Learning Method: **RBT Level:**	Chalk and Talk, YouTube videos, Flipped Class Technique and PPTs. L1, L2

Course outcomes:

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

CO1: Define the basic concepts of network security, classical encryption, number theory, Private key, public key, authentication

CO2: Understand the structure of cryptographic algorithms and their applications.

CO3: Apply the concept of classical encryption techniques to existing standard algorithms.

CO4: Illustrate the significance of cryptographic algorithms and their applications.

CO5: Design the private key and public key, authentication functions for applications.

Suggested Learning Resources:

Text Books:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Fifth Edition, Pearson, 2010

Reference Books:

1. Behrouz Forouzan, "Cryptography and Network Security", edition, TMH, 2007
2. Alfred J. Menezes, Paul C. Van Oorschot and Scott A. Vanstone, "Handbook of Applied Cryptography", edition, CRC Press, Reprint 2001
3. Bruce Scheiner, "Applied cryptography: protocols, algorithms, and source code in C", 2nd edition, Wiley India, 2008
4. Atul Kahate, "Cryptography and Network Security", 2nd edition, TMH, 2006

Web Links: http://www.nptel.ac.in/courses/106105031/

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

Programming Assignments / Mini Projects can be given to improve programming skills

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1			3		2							2		
CO2		2	3					1					2		3
CO3		1	2		3								2	1	
CO4		1		2		3							2		3
CO5		1	2		3								2	1	

High-3, Medium-2, Low-1

SKILL LAB-1st year
Fundamentals of IoT

Course objectives:

1. Understanding of IoT, its components, and its diverse applications across different sectors.
2. Students are able to understand how to interface various sensors and actuators with microcontrollers, enabling them to build functional IoT systems.
3. Students are able to understand communication protocols (UART, I2C, SPI, Wi-Fi, Bluetooth, Zigbee) for connecting and transferring data between IoT devices.
4. Students are able to understand security challenges in IoT systems and educate students on fundamental security measures to protect IoT devices and data from potential threats.

Sl No.	TOPICS	Bloom's Taxonomy Level
1.	What is IoT?, its different perspectives and IoT Architecture	L1,2
2.	Digital & Analog sensors: Temperature, Humidity, Motion, Light, Gas, etc. Actuators: Relay modules, Servos, DC Motors	L1,2
3.	Interfacing sensors with microcontrollers, Overview of IoT platforms (ThingSpeak, Blynk, Arduino Cloud, etc.)	L1,2
4.	Serial Communication protocol: UART, I2C, SPI	L3
5.	Wireless Protocols: Wi-Fi, Bluetooth, Zigbee	L3
6.	Applications of IoT (Smart Home, Industry 4.0, Healthcare, etc.)	L3
7.	IoT Data Management Collecting sensor data	L3
8.	Real-Time Operating Systems (RTOS) for IoT	L3
9.	MQTT and CoAP Protocols for IoT Messaging	L3
10.	AI and Machine Learning at the Edge in IoT	L3
11.	Basic security challenges in IoT	L3
	Course outcomes: At the end of the course the student will be able to: **CO1:** Explain the core concepts of the Internet of Things (IoT), its architecture, components (sensors, actuators, and microcontrollers), and common communication protocols. **CO2:** Demonstrate how to interface and program various sensors (temperature, humidity, motion, etc.) and actuators (relays, motors) with microcontrollers to build practical IoT systems. **CO3:** Analyze security risks in IoT systems and propose basic security strategies to mitigate vulnerabilities, ensuring the integrity and safety of IoT devices and networks.	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2					1	1	1		1	3	3	
CO2	3	3	2					1	1	1		1	3	3	
CO3	3	3	2					1	1	1		1	3	3	

High-3, Medium-2, Low-1

SKILL LAB-2nd year
Verification of digital system using EDA tools (Cadence Software)

Course objectives:

1. Understanding the basics of microwave and waveguides.
2. Understanding the concepts of microwave networks, microwave passive devices and semiconductor devices.
3. Understanding the importance of point sources, arrays and radiations from wires.
4. To understand different types of antennas like aperture, reflector, broadband and Microstrip antennas.

Sl. No.	TOPICS	Bloom's Taxonomy Level
1.	Design of CMOS Inverter circuit using the cadence virtuoso using 180nm technology	L3
2.	Design of CMOS NAND/NOR circuit using the cadence virtuoso using 180nm technology	L3
3.	ASIC implementation of Full Adder using 180nm technology	L3
4.	ASIC implementation of RS/JK Flip Flops using 180nm technology	L3
5.	ASIC implementation of Counters using 180nm technology	L3
6.	Design and implementation of 4 bit shift Registers using 180nm technology	L3
	Course outcomes: At the end of the course the student will be able to: **CO1:** Identify the microwave frequency band, its applications and different types of waveguides **CO2:** Analyse microwave networks, microwave passive devices and semiconductor devices. **CO3:** Apply microwave design principle, microwave tubes and antenna basics.	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2					1	1	1		1	3	3	
CO2	3	3	2					1	1	1		1	3	3	
CO3	3	3	2					1	1	1		1	3	3	

High-3, Medium-2, Low-1

SKILL LAB-3rd year
Antenna Design using EDA Tool

Course objectives:

1. Understanding the fundamental principles and design methodologies of microstrip antennas and microwave components using EDA tools.
2. Understanding the electromagnetic theory and simulation techniques to design and optimize microstrip antenna arrays and microwave circuits.
3. Understanding the design and simulate complete RF front-end components such as LNAs and Power Amplifiers for L-band applications using industry-standard EDA tools.

Sl. No.	TOPICS	Bloom's Taxonomy Level
1.	Micro strip Antenna Design using EDA Tool.	L3
2.	Microwave Components Design using EDA Tool.	L3
3.	Micro strip Antenna (single, linear Circular)	L3
4.	4 element MSA Design (MSA Array)	L3
5.	Power Divider for 4 x 4 MSA array.	L3
6.	Low Noise Amplifier Design for L Band	L3
7.	Power Amplifier Design for L Band	L3
	Course outcomes: At the end of the course the student will be able to: **CO1:** Design and simulate single-element and array microstrip antennas (linear, circular, and 4-element arrays) using EDA tools. **CO2:** Analyze the performance parameters (e.g., gain, return loss, S-parameters) of microwave components like power dividers, LNAs, and PAs using simulation results. **CO3:** Evaluate and optimize L-band amplifier circuits (LNA and PA) for performance metrics such as noise figure, gain, and power efficiency.	

CO-PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2					1	1	1		1	3	3	
CO2	3	3	2					1	1	1		1	3	3	
CO3	3	3	2					1	1	1		1	3	3	

High-3, Medium-2, Low-1