Bachelor of Technology
(Electronics & Communication Engineering)

Scheme & Syllabus
(V Sem to VIII Sem)
w.e.f. 2021-22

Department of Electronics & Communication Engg.
Guru Jambheshwar University of Science & Technology
HISAR- 125001 (HARYANA)

B.Tech., ECE, Semester-5							
Course Code	Course Name	Teaching Schedule L	T	P	Hours/ Week	Credits	Duration of Exam (Hrs)
HSMC301-T	FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS	2	0	0	2	2	3
PCC-ECE301-T	MICROWAVE ENGINEERING	3	0	0	3	3	3
PCC-ECE303-T	EMBEDDED SYSTEM DESIGN	3	0	0	3	3	3
ESC-ECE307-T	DATA STRUCTURE AND APPLICATIONS	3	0	0	3	3	3
ESC-ECE309-T	CONTROL SYSTEM ENGINEERING	3	0	0	3	3	3
Open Elective Course-I		3	0	0	3	3	3
PCC-ECE301-P	MICROWAVE ENGINEERING LAB	0	0	2	2	1	3
PCC-ECE303-P	EMBEDDED SYSTEM DESIGN LAB	0	0	2	2	1	3
PCC-ECE305-P	SKILLS & INNOVATION LAB	0	0	2	2	1	3
*INT-ECE311-P	PRACTICAL TRAINING-I PRESENTATION	0	0	2	2	1	3
Total		17	0	8	25	21	

*Assessment of Practical Training-I will be based on presentation seminar, viva-voce, report and certificate for the practical training taken at the end of 4th semester.

Open Elective Course-I is to be offered by Departments other than ECE.

Note: Students will be allowed to use the scientific calculator only.

29/05/23

B.Tech., ECE, Semester-6							
Course Code	Course Name	Teaching Schedule L	T	P	Hours/ Week	Credits	Duration of Exam (Hrs)
HSMC302-T	ECONOMICS FOR ENGINEERS	2	0	0	2	2	3
PCC-ECE302-T	INTERNET OF THINGS (IOT)	3	0	0	3	3	3
PCC-ECE304-T	VLSI DESIGN	3	0	0	3	3	3
PCC-ECE306-T	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	3	0	0	3	3	3
Program Elective Course-I		3	0	0	3	3	3
Open Elective Course-II		3	0	0	3	3	3
PCC-ECE302-P	INTERNET OF THINGS (IOT) LAB	0	0	2	2	1	3
PCC-ECE304-P	VLSI DESIGN LAB	0	0	4	4	2	3
PCC-ECE306-P	LINEAR INTEGRATED CIRCUITS & APPLICATIONS LAB	0	0	2	2	1	3
Total		17	0	8	25	21	

Note: The students will have to undergo Practical Training -II of 4 to 6 weeks duration during summer vacations which will be evaluated in 7th sem.

Open Elective Course-II is to be offered by Departments other than ECE.

Note: Students will be allowed to use the scientific calculator only.

29/05/23

B.Tech., ECE, Semester-7							
Course Code	Course Name	Teaching Schedule L	T	P	Hours/ Week	Credits	Duration of Exam (Hrs)
PCC-ECE401-T	DIGITAL SIGNAL PROCESSING	3	0	0	3	3	3
PCC-ECE403-T	ADVANCED MOBILE COMMUNICATIONS	3	0	0	3	3	3
PCC-ECE405-T	DIGITAL SYSTEM DESIGN	3	0	0	3	3	3
Program Elective Course-II		3	0	0	3	3	3
Open Elective Course-III		3	0	0	3	3	3
PCC-ECE401-P	DIGITAL SIGNAL PROCESSING LAB	0	0	2	2	1	3
PCC-ECE405-P	DIGITAL SYSTEM DESIGN LAB	0	0	4	4	2	3
Program Elective Course-II Lab		0	0	2	2	1	3
*PROJ-ECE413-P	MINOR PROJECT	0	0	8	8	4	3
**INT-ECE415-P	PRACTICAL TRAINING-II PRESENTATION	0	0	2	2	1	3
***MC-ECE417-P	GENERAL PROFICIENCY	0	0	0	0	0	3
Total		15	0	18	33	24	

Open Elective Course-III is to be offered by Departments other than ECE.

* The minor project will be completed and evaluated at the end of the 7th semester on the basis of its implementation, presentation, viva-voce and report.

** Assessment of Practical Training-II will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of 6th sem.

*** A viva of the students will be taken by external examiner and Chairperson of the Department(Internal Examiner) at the end of the semester.

***MC-Mandatory Course which will be a non-credit course and the student has to get pass marks in order to qualify for the award of degree.

Note: Students will be allowed to use the scientific calculator only.

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B.Tech., ECE, Semester-8							
Course Code	Course Name	Teaching Schedule			Hours/ Week	Credits	Durations of Exam (Hrs)
		L	T	P			
Program Elective Course-III		3	0	0	3	3	3
Program Elective Course-IV		3	0	0	3	3	3
Program Elective Course-V		3	0	0	3	3	3
Program Elective Course-III Lab		0	0	2	2	1	3
Program Elective Course-V Lab		0	0	2	2	1	3
*PROJ-ECE428-P	Major Project	0	0	12	12	6	3
Total		09	0	14	23	17	

OR

Course Code	Course Name	Teaching Schedule			Hours/ Week	Credits	Durations of Exam (Hrs)
		L	T	P			
ITR	Full Semester Industrial Training ECE-452-P	-	-	-	-	11	-
Industrial Training with any 2 Program Electives taken from the above list		-	-	-	-	3+3	-
Total		-	-	-	-	17	

* The major project will be completed and evaluated at the end of the 8th semester on the basis of its implementation, presentation, viva-voce and report.

Note: Students will be allowed to use the scientific calculator only.

Dr. Raeesh 29/05/23

Dr. Kuldeep Singh

PROGRAM ELECTIVE COURSES (PEC)

Offered for

B.Tech. Programmes

w.e.f. 2021-22

29/01/23

6th Semester

Program Elective Course-I

B.Tech. ECE, Program Elective Course-I	
Course Code	**Course Name**
PEC-ECE308-T	CONSUMER & INDUSTRIAL ELECTRONICS
PEC-ECE310-T	COMPUTER NETWORKS
PEC-ECE312-T	SATELLITE & RADAR COMMUNICATION
PEC-ECE314-T	POWER ELECTRONICS
PEC-ECE316-T	OPTICAL COMMUNICATION
PEC-ECE318-T	DRONE AND ANTI-DRONE TECHNOLOGY
PEC-ECE320-T	VLSI FABRICATION TECHNOLOGY
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

7th Semester

Program Elective Course-II

B.Tech. ECE, Program Elective Course-II	
Course Code	**Course Name**
PEC-ECE407-T	SPECIAL TOPICS IN VLSI
PEC-ECE409-T	ANTENNA & WAVE PROPAGATION
PEC-ECE411-T	ARTIFICAL INTELLIGENCE & MACHINE LEARNING
PEC-ECE413-T	OBJECT ORIENTED PROGRAMMING USING JAVA
PEC-ECE415-T	COMPUTER GRAPHICS
PEC-ECE417-T	ADVANCE COMPUTER ARCHITECTURE
PEC-ECE407-P	SPECIAL TOPICS IN VLSI LAB
PEC-ECE409-P	ANTENNA & WAVE PROPAGATION LAB
PEC-ECE411-P	ARTIFICAL INTELLIGENCE & MACHINE LEARNING LAB
PEC-ECE413-P	OBJECT ORIENTED PROGRAMMING USING JAVA LAB
PEC-ECE415-P	COMPUTER GRAPHICS LAB
PEC-ECE417-P	ADVANCE COMPUTER ARCHITECTURE LAB
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

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8th Semester

Program Elective Course-III

B.Tech. ECE, Program Elective Course-III	
Course Code	**Course Name**
PEC-ECE402-T	SYSTEM VERILOG
PEC-ECE404-T	ROBOTICS
PEC-ECE406-T	MICRO AND NANO ELECTRO MECHANICAL SYSTEMS
PEC-ECE408-T	DIGITAL IMAGE PROCESSING
PEC-ECE410-T	PHOTONIC SYSTEMS
PEC-ECE412-T	DATA ANALYTICS AND MINING
PEC-ECE402-P	SYSTEM VERILOG LAB
PEC-ECE404-P	ROBOTICS LAB
PEC-ECE406-P	MICRO AND NANO ELECTRO MECHANICAL SYSTEMS LAB
PEC-ECE408-P	DIGITAL IMAGE PROCESSING LAB
PEC-ECE410-P	PHOTONIC SYSTEMS LAB
PEC-ECE412-P	DATA ANALYTICS AND MINING LAB
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

Program Elective Course-IV

B.Tech. ECE, Program Elective Course-IV	
Course Code	**Course Name**
PEC-ECE414-T	ANALOG CMOS IC DESIGN
PEC-ECE416-T	WIRELESS SENSOR AND NETWORKS
PEC-ECE418-T	ADAPTIVE SIGNAL PROCESSING
PEC-ECE420-T	WEB TECHNOLOGIES
PEC-ECE422-T	RADIO OVER FIBER
PEC-ECE424-T	MULTIMEDIA TECHNOLOGIES
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

Program Elective Course-V

B.Tech. ECE, Program Elective Course-V	
Course Code	**Course Name**
PEC-ECE426-T	CLOUD COMPUTING
PEC-ECE428-T	SYSTEM DESIGN USING FPGAS
PEC-ECE430-T	MOBILE APPLICATION DEVELOPMENT
PEC-ECE432-T	CYBER SECURITY
PEC-ECE434-T	NEURAL NETWORKS AND DEEP LEARNING
PEC-ECE436-T	BATTERY MANAGEMENST SYSTEM
PEC-ECE426-P	CLOUD COMPUTING LAB
PEC-ECE428-P	SYSTEM DESIGN USING FPGAS LAB

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PEC-ECE430-P	MOBILE APPLICATION DEVELOPMENT LAB
PEC-ECE432-P	CYBER SECURITY LAB
PEC-ECE434-P	NEURAL NETWORKS AND DEEP LEARNING LAB
PEC-ECE436-P	BATTERY MANAGEMENST SYSTEM LAB
*Any one MOOC/SWAYAM /equivalent course not studied earlier.	

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OPEN ELECTIVE COURSES

Offered for

B.Tech. Programmes

w.e.f. 2021-22

4	OE-ECE-392-T	DRONE AND ANTI-DRONE TECHNOLOGY	Electronics and Communication Engineering	3
5	OE-FT-392-T	FOOD SAFETY, QUALITY AND REGULATIONS	Food Technology	3
6	OE-CE-392-T	INTRODUCTION TO FLUID MECHANICS	Civil Engineering	3
7	OE-EE-392-T	RENEWABLE ENERGY RESOURSES	Electrical Engineering	3

7th Semester

Open Elective Course-III

S. No.	Course Code	Course Nomenclature	Department	Credits
1	OE-PTG-491-T	FUNDAMENTALS OF PACKAGING	Printing Technology	3
2	OE-ME-491-T	COMPUTER AIDED DESIGN AND MANUFACTURING	Mechanical Engineering	3
3	OE-CSE-491-T	STATISTICAL COMPUTING	Computer Science and Engineering	3
4	OE-ECE-491-T	INTRODUCTION TO 5G/6G TECHNOLOGY	Electronics and Communication Engineering	3
5	OE-FT-491-T	INSTRUMENTAL ANALYSIS OF FOODS	Food Technology	3
6	OE-CE-491-T	ENVIRONMENTAL ENGINEERING	Civil Engineering	3
7	OE-EE-491-T	ENERGY MANAGEMENT AND AUDIT	Electrical Engineering	3

5th Semester

Open Elective Course-I

S. No.	Course Code	Course Nomenclature	Department	Credits
1	OE-PTG-391-T	FUNDAMENTALS OF PRINTING	Printing Technology	3
2	OE-ME-391-T	INDUSTRIAL ENGEERING	Mechanical Engineering	3
3	OE-CSE-391-T	INFORMATION AND CYBER SECURITY	Computer Science and Engineering	3
4	OE-ECE-391-T	INTRODUCTION TO INTERNET OF THINGS (IOT)	Electronics and Communication Engineering	3
5	OE-FT-391-T	PROCESSING AND PRESERVATION OF FOODS	Food Technology	3
6	OE-CE-391-T	INTRODUCTION TO CIVIL ENGINEERING	Civil Engineering	3
7	OE-EE-391-T	UTILIZATION OF ELECTRICAL ENERGY	Electrical Engineering	3

6th Semester

Open Elective Course-II

S. No.	Course Code	Course Nomenclature	Department	Credits
1	OE-PTG-392-T	GRAPHICS DESIGN FUNDAMENTALS	Printing Technology	3
2	OE-ME-392-T	SOLAR ENERGY ENGEERING	Mechanical Engineering	3
3	OE-CSE-392-T	INTRODUCTION TO SOFT COMPUTING	Computer Science and Engineering	3

29/05/23

Detailed Syllabus

of

B.Tech.(ECE)

5^{th}-8^{th} Semester

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

HSMC301-T

General Course Information

Course Credits: 2 Type: HSMC Mode: Lectures (L) Teaching schedule L T P : 2 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units..

Pre-requisites: None

Sr. No.	Course Outcomes At the end of the semester,students will be able to:	RBT Level
CO1	**Define** fundamental concepts of management	LOTS:Level 1 : (Remember)
CO2	**Explain** the basic principles of management related to planning and decision making, HRM and motivation, and leadership.	LOTS: Level 2: (Understand)
CO3	**Apply** the managerial skills to solve real world management problems.	LOTS: Level 3: (Apply)
CO4	**Identify** leadership roles in various scenarios.	HOTS: Level 4: (Analyse).
CO5	**Evaluate** a business model based on principles of management.	HOTS: Level 5: (Evaluate)
CO6	**Prepare** a plan for a start up in IT sector.	HOTS: Level 6: (Create)

Course Content

Unit I

Management Definition: Scope and process of management, Managerial Roles. Levels of Management, Managerial Skills, Challenges of Management, Evolution of Management. Scientific and Administrative Management, The Behavioural approach, The Quantitative approach. The Systems Approach, Contingency Approach. IT Approach.

Unit II

Planning and Decision Making: General Framework for Planning, Planning Process. Types of plans, Management by objectives, Development of business strategy.

Decision making and Problem Solving: Programmed and Non-Programmed Decisions. Steps in Problem Solving and Decision Making, Bounded Rationality and Influences on Decision Making. Group Problem Solving and Decision Making, Creativity and Innovation in Managerial Work.

Unit III

Organization, HRM and Controls: Organizational Design & Organizational Structures. Delegation, Empowerment, Centralization, Decentralization. Organizational culture. Organizational climate and Organizational change, Talent management. Talent management Models and strategic human Resource planning. Recruitment and selection; Training and development, Performance Appraisal. Types of controls and controlling Techniques.

FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS

HSMC301-T

Unit IV

Leading and Motivation: Leadership, Power and authority. Leadership styles; Behavioural leadership. Situational leadership, Leadership skills, Leader as mentor and coach, Leadership during adversity and crisis: Handling employee and customer complaints, Team leadership. Motivation: Types of motivation. Relationship between motivation, performance and engagement. Content motivational theories.

TEXT AND REFERENCE BOOKS:

1. Robert N Lussier, *Management Fundamentals*, 5th edition. Cengage Learning. 2013.
2. Stephen P. Robbins, *Fundamentals of Management*, Pearson Education. 2009.
3. Weihrich Koontz, *Essentials of Management*, fifth edition. Tata Mc Graw Hill, 1990.
4. Dubrin Andrew, *Management Essentials*. 9th edition, Cengage Learning. 2012.

CO-PO Articulation Matrix: FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS Course (HSMC301-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Define fundamental concepts of management (LOTS: L1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO2. Explain the basic principles of management related to planning and decision making, HRM and motivation, and leadership. (LOTS: L2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO3. Apply the managerial skills to solve real world management problems. (LOTS: L3: Apply)	2	–	–	2	–	–	–	–	–	–	–	–	–	–	–
CO4. Identify leadership roles in various scenarios. (HOTS: L4: Analyse).	–	–	–	–	–	–	–	3	3	–	–	–	–	–	–
CO5. Evaluate business model based on principles of management HOTS: L5: (Evaluate)	2	3	2	–	–	–	–	–	–	–	–	–	–	–	–
CO6. Prepare a plan for start-up in IT sector HOTS: L5: (Create).	3	–	–	–	2	–	–	–	–	–	–	–	–	–	–
Level of Attainment:															

MICROWAVE ENGINEERING

PCC-ECE301-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; (Max. Marks: 100 Internal: 30; External: 70)** Three minor tests. each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course outcomes At end of the semester: Student will be able to	RBT Level
CO-1	**Define** the terminology related to microwave devices and systems.	LOTS: L1 (Define)
CO-2	**Understand** the working of microwave systems. transmission mediums, active and passive microwave devices.	LOTS: L2 (Understand)
CO-3	**Apply** the knowledge gained to predict the mode. wavelength, velocity, impedance and other parameters of the waves propagating in microwave systems.	LOTS: L3 (Apply)
CO-4	**Analyse** the scattering matrix of the different microwave devices and systems	HOTS: L4 & L5 (Analyze)
CO-5	**Design** microwave devices such as power dividers and directional couplers.	HOTS: L6 (Design)

Course Contents

Unit- I

Introduction to Microwaves and Microwave Transmission Mediums: Introduction to microwaves. advantages and applications of microwaves. Rectangular Waveguides: solution of wave equation, TE and TM modes of propagation in rectangular waveguides. wave cut-off frequency. intrinsic impedance, phase velocity. group velocity, guided wavelength. Introduction to circular waveguides. stripline, microstrip line.

UNIT-II

Microwave Passive Components: Microwave network analysis using Scattering matrix, reciprocal and lossless networks. Microwave cavities. Power Dividers: E-plane Tee. H-plane Tee. Magic Tee. Hybrid ring (rat-race). Directional Couplers: Bethe hole coupler. Two Hole directional coupler, coupled line directional coupler.

Waveguide corners, bends and twists, terminators and attenuators. Ferrite Devices: Microwave Circulator and isolator.

UNIT-III

Microwave Tubes: High-frequency limitations of conventional vacuum tubes. Klystrons: Construction and Operation of Two cavity Klystron, velocity modulation and bunching. Reflex Klystron. Travelling-Wave Tube (TWT): Slow wave structures, amplification process in TWT. Microwave crossed-field tubes: cylindrical magnetron.

UNIT-IV

Microwave Solid State Devices: Microwave Bipolar Transistor. Microwave Tunnel Diode: principal of operation, characteristics. Gunn-Effect and diodes: Negative resistance. Two-valley theory. Avalanche Transit-Time Devices: Read diode, IMPATT Diode.

Microwave Measurements: Microwave measuring devices and instruments: VSWR meter, spectrum analyzer, network analyzer, tunable detector, slotted-line carriage, power meter. Microwave Measurements: Microwave bench set-up, frequency measurements, microwave power measurement, VSWR measurement. Impedance measurement, measurement of insertion loss and attenuation.

TEXT BOOKS AND REFERENCE BOOKS:

1. S.Y. Liao, Microwave Devices & Circuits; PHI 3rd Edn.
2. S. Vasuki, D Margaret Helena, R Rajeswari, Microwave Engineering; McGraw Hill Education.
3. A. Das and S.K. Das, Microwave Engineering: McGraw Hill Education.
4. David M Pozar, Microwave Engineering; John Wiley & Sons., 4th Edn, 2011.
5. Sushrut Das, Microwave Engineering; Oxford University Press, 2014.

CO-PO Articulation Matrix of MICROWAVE ENGINEERING (PCC-ECE301-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Define the terminology related to microwave devices and systems. **LOTS: L1 (Define)**	3	3	3	1	1	-	-	-	-	-	-	1	2	2	2
CO2. **Understand** the working of microwave systems, transmission mediums, active and passive microwave devices. **LOTS: L2 (Understand)**	3	3	3	2	1	-	-	-	-	-	-	2	2	2	3
CO3. **Apply** the knowledge gained to predict the mode, wavelength, velocity, impedance and other parameters of the waves propagating in microwave systems. **LOTS: L3 (Apply)**	3	3	3	2	1	1	-	-	-	-	-	2	3	3	3
CO4. **Analyse** the scattering matrix of the different microwave devices and systems **HOTS: L4 (Analyse)**	3	3	3	2	2	2	-	-	-	-	-	2	3	3	3
CO5. **Design** microwave devices such as power dividers and directional couplers. **HOTS: L6 (Design)**	3	3	3	2	2	2	-	-	-	-	-	2	3	3	3
Level of Attainment:															

MICROWAVE ENGINEERING

PCC-ECE301-T

EMBEDDED SYSTEM DESIGN

PCC-ECE303-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching schedule L T P: 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog and Digital Electronics

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able to:**	**RBT Level**
CO1	**Define and describe** the terminologies and fundamental principles related to processors, micro-controllers and embedded systems.	LOTS: L1 (Remember)
CO2	**Understand and explain** the function and working of different units of the microcontroller	LOTS: L2 (Understand)
CO3	**Apply** the knowledge of the microcontroller architecture for writing the programs.	LOTS: L3 (Apply)
CO4	**Analyze** the working flow of any circuit/program implemented using PIC.	HOTS: L4 (Analyze)
CO5	**Design** an embedded system circuit with PIC microcontroller.	HOTS: L6 (Create)

Course Contents

UNIT-I

PIC Microcontroller Architecture: Introduction to PIC Microcontrollers. Processor Architectures: Harvard vs. Von Neumann, CISC vs. RISC. Comparison between PIC10, PIC12, PIC14, PIC16, PIC18 devices. PIC 16 Microcontroller, Architecture and pipelining. Block diagram, program memory considerations, Addressing modes, CPU Registers. Instruction set, simple operations.

UNIT -II

Interrupt and I/O Ports of PIC MCU: Interrupt logic, Timer2 scalar initialization, Interrupt service routine, Loop time subroutine, External interrupts and timers. Synchronous serial port module, Serial peripheral device. Output port expansion, Input port expansion, UART.

EMBEDDED SYSTEM DESIGN

PCC-ECE303-T

CO-PO Articulation Matrix of EMBEDDED SYSTEM DESIGN (PCC-ECE303-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Define and describe the terminologies and fundamental principles related to processors, micro-controllers and embedded systems LOTS : L1 (Remember).	3	2	2	1	-	-	-	-	-	1	1	3	3	2	3
CO2 Understand and explain the function and working of different units of the microcontroller LOTS: L2 (Understand).	3	2	2	1	-	1	-	-	-	1	1	3	3	3	3
CO3 Apply the knowledge of the microcontroller architecture for writing the programs LOTS: L3 (Apply).	3	2	3	1	-	-	-	-	-	1	2	3	3	3	3
CO4 Analyze the working/flow of any circuit/program implemented using PIC HOTS: L4 (Analyze).	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
CO5 Design an embedded system circuit with PIC microcontroller HOTS: L6 (Create)	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
Level of attainments:															

UNIT -III

Programming with PIC Microcontroller: Arithmetic operations. Bit addressing, Loop control, stack operations, subroutines, RAM direct addressing, State machines. Oscillators, Timer interrupts, memory mapped input/output. Development tools/environments, assembly language programming style, interpreters, high level languages, Intel hex format object files, Debugging.

UNIT -IV

Designing with PIC Microcontroller: PWM Motor control, Temperature sensor, Pressure sensor, DC Motor, Stepper motor, Servo motor, Analog to digital converter, Digital to analog converter, seven segment display, LCD interfacing with PIC 16 Microcontroller.

TEXT BOOKS AND REFERENCE BOOKS:

1. Design with PIC Microcontroller, by John B. Peatman, Pearson.
2. PIC Microcontroller and Embedded Systems: using assembly and C for PIC 18 by Muhammad Ali Mazidi, Pearson.
3. Microcontroller Programming: the Microchip PIC by Julio Sanchez, Maria P. Canton, CRC Press.
4. Embedded C programming and the microchip PIC by Richard H. Barnett, Larry O' Cull, Delmar Cengage Learning.

Unit IV

Table: Hashing, Hash tables, hash function and collisionresolution.

Sorting: Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort,Quick sort, Merge sort.

TEXT AND REFERENCE BOOKS:

1. Aho, A. V., Ullman, J. D., and Hopcroft, J. E., *Data Structures and Algorithms*, Addison-Wesley, 1983.
2. LangsamYedidyah, Augenstein J Moshe, Tenenbaum M Aaron, *Data Structures using C and C++*, 3rdedition, PHI, 2009.
3. Cormen, T. H., Leiserson, C. E., Rivest, R. L. and Stein, C., *Introduction to Algorithms*, MIT Press, 2009.
4. Robert L. Kruse, *Data Structure and Program Design in C*, Pearson Education India, 2007.
5. Weiss, M. A., *Data Structures and Algorithm Analysis in C++*, Addison-Wesley, 2007.
6. Sahni, S., *Data Structures, Algorithms, and Applications in C++*, WCB/McGraw-Hill, 2001.

CO-PO Articulation Matrix: DATA STRUCTURE AND APPLICATIONS (ESC-ECE307-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Describe various types of data structures and operations that can be implemented on these data structures **LOTS: L1 : (Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 Demonstrate the use of various data structures and their related operations **LOTS: L2: (Understand).**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 Apply data structure to solve computational problems **LOTS: L3: (Apply).**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4 Compare the suitability of alternative data structures and prescribed operations for various problem situation **HOTS: L4: (Analyse).**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 Create sorting on various tables **HOTS: L5: (Create)**	2	2	2	2	1	–	–	1	–	–	1	1	2	1	2
Level of Attainment:															

CONTROL SYSTEM ENGINEERING

ESC-ECE309-T

General Course Information

Course Credits: 3 Type: ESC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Fourier Series, Network Theory

Sr. No.	Course outcomes of: At end of the semester, students will be able to	RBT Level
CO1	**Define** various types of control systems and feedback control mechanism	LOTS: L1 (Define)
CO2	**Understand** various time domain and frequency domain tools used for the analysis and design of linear control systems.	LOTS: L2 (Understand)
CO3	**Illustrate** time domain analysis of 2nd order system.	LOTS: L3 (Illustrate)
CO4	**Analyse** the stability of the system using techniques based on transfer function of system	HOTS: L4 (Analyze)
CO5	**Evaluate** compensation networks, controllers and state space models.	HOTS: L5 (Evaluate)

Course Contents

UNIT- I

Input / Output Relationship: System / Plant model, illustrative examples of plants & their inputs and outputs, open loop & closed loop control system & their illustrative examples. Mathematical modeling and representation of physical systems. Concept of transfer function, relationship between transfer function and impulse response, order

CONTROL SYSTEM ENGINEERING

ESC-ECE309-T

DATA STRUCTURE AND APPLICATIONS

ESC-ECE307-T

General Course Information

Course Credits: 3 Type: ESC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Programming in C

Sr. No.	CourseOutcomes At the end of the semester,students will be able to:	RBT Level
CO1	Describe various types of data structures and operations that can be implemented on these data structures	LOTS:Level 1 : (Remember)
CO2	Demonstrate the use of various data structures and their related operations	LOTS: Level 2: (Understand)
CO3	Apply data structure to solve computational problems	LOTS: Level 3: (Apply)
CO4	Compare the suitability of alternative data structures and prescribed operations for various problem situations.	HOTS: Level 4: (Analyse)
CO5	Create sorting on various tables.	HOTS: Level 5: (Create)

Course Content

Unit I

Introduction to data structures and their types. Abstract data types, Linear lists: Arrays and linked lists: memory representations. implementing operations like traversing, searching, inserting and deleting etc. Applications of arrays and linked lists.

Unit II

Stack and Queue: Static and linked implementations. Operations and Applications. Circular queues, Tress. Binary trees and related terminology. Tree traversals (Recursive), Binary Search Trees implementation and operations.

Unit III

Tree: Height Balanced or AVL trees and B trees. Graph definitions and related terminology, memory representations and related operations (traversal, insertion, deletion, search). Path Matrix, Warshall'sShortest path algorithm

DATA STRUCTURE AND APPLICATIONS

ESC-ECE307-T

of a system, block diagram algebra, signal flow graphs: Mason's gain formula & its application, characteristic equation, derivation of transfer functions of electrical and electromechanical systems.

UNIT- II

Time Domain Analysis: Typical test signals, time response of first order systems to various standard inputs, time response of 2nd order system to step input, time domain specifications, steady state error and error constants, concept of stability, pole-zero configuration and stability, necessary and sufficient conditions for stability, Hurwitz stability criterion, Routh stability criterion and relative stability, Root locus concept, development of root loci for various systems, stability considerations.

UNIT- III

Frequency Domain Analysis: Relationship between frequency response and time-response for 2nd order system, polar, Nyquist, Bode plots, stability, Gain-margin and Phase Margin, relative stability, frequency response specifications.

UNIT- IV

Compensation: Necessity of compensation, compensation networks, application of lag and lead compensation, basic modes of feedback control, proportional, integral and derivative controllers.

Control Components: Synchros, servomotors, stepper motors, magnetic amplifier.

State variable Analysis: Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

TEXT BOOKS AND REFERENCE BOOKS:

1. Control System Engineering: I.J. Nagrath & M. Gopal: New Age Publishers.
2. Automatic Control Systems: B.C. Kuo, PHI. Publishers.
3. Control System Engineering: U.A. Bakshi,V.U. Bakshi: Technical Publications.
4. Modern Control Engg: K. Ogata: PHI. Publishers.
5. Control Systems - Principles & Design: Madan Gopal: Tata Mc Graw Hill. Publishers.
6. Modern Control Engineering, R.C. Dorf & Bishop: Addison-Wesley Publishers.

CO-PO Articulation Matrix of CONTROL SYSTEM ENGINEERING (ESC-ECE309-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Define** various types of control systems and feedback control mechanism **LOTS: L1 (Define)**	3	2	---	1	--	1	1	1	3	1	2	1	1	2	3
CO2 **Understand** various time domain and frequency domain tools used for the analysis and design of linear control systems. **LOTS: L2 (Understand)**	3	3	2	3	3	3	3	2	3	2	3	2	3	2	2
CO3 **Illustrate** time domain analysis of 2nd order system. **LOTS: L3 (Illustrate)**	3	2	2	2	2	3	2	1	3	2	3	2	3	2	3
CO4 **Analyse** the stability of the system using techniques based on transfer function of system. **HOTS: L4 (Analyse)**	3	2	2	2	3	3	3	2	3	3	3	3	2	2	2
CO5 **Evaluate** compensation networks, controllers and state space models. **HOTS: L5 (Evaluate)**	3	3	2	3	3	3	3	2	3	3	3	3	3	3	3
Level of Attainment:															

MICROWAVE ENGINEERING LAB

PCC-ECE301-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: EMI lab, Network Analysis and Synthesis lab

Sr. No.	Course outcomes At end of the semester: Student will be able to	RBT Level
CO1	Apply their knowledge to use microwave test equipment, such as frequency meter, VSWR meter and power meters, to measure and verify the performance of microwave components and systems.	LOTS: L3 (Apply)
CO2	Analyze the performance of microwave components and systems based on their measured data.	HOTS: L4 & L5 (Analyze and Evaluate)
CO3	Design microwave circuits or systems using their understanding of the underlying principles and their skills in CAD tools and test equipment.	HOTS: L6 (Create)
CO4	Create written records for the given assignments with problem definition, design of solution and conclusion.	HOTS: L6 (Create)

CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To study waveguide components.
2. To study the characteristics of Reflex Klystron
3. To measure frequency of microwave source and demonstrate relationship among guide dimensions, free space wave length and guide wavelength
4. To measure coupling and directivity of direction couplers.
5. To measure insertion loss, isolation of a three-port circulator.
6. To measure attenuation of microwave attenuators.
7. To study power division in E-plane Tee and H-plane Tee.
8. To study power division in magic Tee.
9. To study field pattern of various modes inside a rectangular waveguide.
10. To study the V-I characteristics of GUNN diode.
11. Design and simulate the following:
    i. 3-dB branchline coupler
    ii. Rat-race hybrid ring
    iii. Wilkinson power divider

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of MICROWAVE ENGINEERING LAB (PCC-ECE301-P)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Apply the knowledge of instruction set, addressing modes and architecture in writing programs.	3	3	3	2	3	1	-	-	-	-	-	2	3	3	3
CO2. Analyze the performance of microwave components and systems based on their measured data. **HOTS: L4 & L5 (Analyze)**	3	3	3	3	3	1	-	-	-	-	-	2	3	3	3
CO3. **Design** microwave circuits or systems using their understanding of the underlying principles and their skills in CAD tools and test equipment. **HOTS: L6 (Create)**	3	3	3	3	3	1	-	-	-	-	-	2	3	3	3
CO4. **Create** written records for the given assignments with problem definition, design of solution and conclusion. **HOTS: L6 (Create)**	-	-	1	1	1	2	1	3	3	3	3	2	1	1	2
CO5. **Demonstrate** ethical practices while solving problems individually or in groups. **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	2	1	1	1
Level of Attainments:															

EMBEDDED SYSTEM DESIGN LAB

PCC-ECE303-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods ; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Analog and Digital Circuits

Sr. No.	**Course Outcomes:** **At the end of the semester, students will be able to:**	**RBT Level**
CO1	Apply the knowledge of instruction set, addressing modes and architecture in writing programs.	LOTS: L3 (Apply)
CO2	**Analyze and evaluate** the working of the microcontroller while implementing a program for a given application.	HOTS: L4 & L5 (Analyze & Evaluate)
CO3	**Integrate** knowledge of external devices and microcontroller in writing programs for interfacing the devices.	HOTS: L6 (Create)

EMBEDDED SYSTEM DESIGN LAB

PCC-ECE303-P

CO4	**Create** written records for the given experiments with problem definition, solution, observations and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while performing lab experiments individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Write an assembly language program to perform addition, subtraction, multiplication and division operation using PIC 16 Microcontroller.
2. Write an assembly language program to perform 16-bit addition and subtraction operation using PIC Microcontroller.
3. Write an assembly language program to perform the addition of a series of numbers using PIC Microcontroller.
4. Write an assembly language program to perform logical operations using PIC Microcontroller.
5. Write an assembly language program for delay calculation using PIC Microcontroller.
6. Write a program for the blinking of LED's using PIC Microcontroller.
7. Write an assembly language program to find the largest number from a given series.
8. Write an assembly language program to find the smallest number from a given series.
9. Write an assembly language program to sort a given number of series in ascending order.
10. Seven segment display interfacing with PIC Microcontroller.
11. LCD Interfacing with PIC Microcontroller.
12. DC Motor interfacing with PIC Microcontroller.
13. Stepper motor interfacing with PIC Microcontroller.
14. Temperature sensor interfacing with PIC Microcontroller.
15. Accelerometer sensor interfacing with PIC Microcontroller.
16. Simple project (Any topic related to the scope of the course).

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institutions as per the scope of the syllabus.

CO-PO Articulation Matrix of Embedded System Design Lab (PCC-ECE303-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Apply the knowledge of instruction set, addressing modes and architecture in writing programs **LOTS: L3 (Apply).**	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2. **Analyze and evaluate** the working of the microcontroller while implementing a program for a given application **HOTS: L4 & L5 (Analyze & Evaluate).**	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3. **Integrate** knowledge of external devices and microcontroller in writing programs for interfacing the devices **HOTS: L6 (Create).**	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4. Create written records for the given experiments with problem definition, solution, observations and conclusions **HOTS: L6 (Create)**	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5. **Demonstrate** ethical practices while performing lab experiments individually or in groups **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

SKILLS & INNOVATION LAB

PCC-ECE305-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.)

Pre-requisites: Network Analysis and Synthesis lab, Analog Electronics- I Lab, Analog Electronics -II Lab

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able to :**	**RBT Level**
CO 1	**Explain** PCB design and fabrication process.	LOTS: L1 (Remember)
CO 2	**Understand** Circuit schematic design, PCB layout design and fabrication process.	LOTS: L2 (Understand)
CO 3	**Implement** knowledge of Electronic circuit design, layout design and fabrication process.	LOTS: L3 (Apply)
CO 4	**Investigate** Circuit schematic design, PCB design and fabrication process.	HOTS: L5 (Evaluate)

SKILLS & INNOVATION LAB

PCC-ECE305-P

CO 5	**Design** and construct PCB for electronic circuits.	HOTS: L6 (Create)

LIST OF EXPERIMENTS

1. Introduction of circuit schematic and layout tool.
2. Design schematic of regulated DC power supply.
3. Design layout (Silk layer and copper layer) of regulated DC power supply.
4. Introduction of Design rule check (DRC) and Netlist.
5. To fabricate a PCB for regulated DC power supply circuit including image transfer, etching, drilling and soldering.
6. To test electronic circuit implemented on PCB.
7. Design schematic of electronic circuit of practical importance.
8. Design layout (Silk layer and copper layer) of electronic circuit of practical importance.
9. To fabricate PCB and test electronic circuit of practical importance.
10. To study data sheets of diode.
11. To study data sheets of transistor.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Matrix of SKILL & INNOVATION LAB (PCC-ECE305-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Explain** PCB design and fabrication process. **LOTS: L1 (Remember)**	3	3	3	2	2	3	1	2	2	3	3	2	3	2	2
CO2 **Understand** Circuit schematic design. PCB layout design and fabrication process. **LOTS: L2 (Understand)**	3	3	3	2	3	3	2	-	3	3	3	2	3	3	3
CO3 **Implement** knowledge of electronic circuit design, layout design and fabrication process. **LOTS: L3 (Apply)**	3	3	3	2	2	3	2	2	2	3	2	2	3	2	2
CO4 **Investigate** Circuit schematic design. PCB design and fabrication process. **HOTS: L5 (Evaluate)**	3	3	3	2	2	3	1	2	3	3	3	3	3	3	3
CO5 **Design** and construct PCB for electronic circuits. **HOTS: L6 (Create)**	3	3	3	2	3	3	1	2	3	3	3	3	3	3	3

ECONOMICS FOR ENGINEERS

HSMC302-T

General Course Information

Course Credits: 2 Type: HSMC Mode: Lectures (L) Teaching schedule L T P : 2 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Two minor examinations (20 marks), Class Performance measured through percentage of lectures attended (4 marks), assignments (6 marks), and the end- semester examination (70 marks). For the end semester examination, nine questions are to be set by the examiner. A candidate is required to attempt 5 questions in all. All questions carry equal marks. Question number 1 will be compulsory and based on the entire syllabus. It will contain seven parts of 2 marks each. Question numbers 2 to 9 will be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt the remaining four questions by selecting one question from each of the four units..

Pre-requisites: None

Sr. No.	Course Outcomes At the end of the semester,students will be able to:	RBT Level
CO1	Outline the principles of economics in general and economics in Indian context	LOTS:Level 1 : (Remember)
CO2	Discuss concepts related to economics in general and particularly relevant to Indian scenario.	LOTS: Level 2: (Understand)
CO3	Apply the principles of economics for solving problems related to Engineering sector.	LOTS: Level 3: (Apply)
CO4	Carry out cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives.	HOTS: Level 4: (Analyse).
CO5	Judge the issues and challenges of sustainable development	HOTS: Level 5: (Evaluate)

Course Content

Unit I

Definition of Economics- various definitions. Nature of economic problem. Production possibility curve. Economics laws and their nature. Relation between Science, Engineering, Technology and Economics. Concepts and measurement of utility, Law of Diminishing Marginal Utility. Law of equi-marginal utility - its practical applications and importance

Unit II

Meaning of Demand. Individual and Market demand schedules. Law of demand, shape of demand curve. Elasticity of Demand, measurement of elasticity of demand, factors affecting elasticity of demand, practical importance and applications of the concept of elasticity of demand.

Meaning of production and factors of production; Law of variable proportions. Returns to scale. Internal and External economies and diseconomies of scale.

Unit III

Various concepts of cost- Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost etc. in short run and long run both.

ECONOMICS FOR ENGINEERS

HSMC302-T

Meaning of Market, Types of Market - Perfect Competition. Monopoly. Oligopoly. Monopolistic Competition (Main features of these markets) Issues. Strategies and challenges for sustainable development for developing economies

Unit IV

Elements of Business/Managerial Economics and forms of organizations, Cost & Cost Control Techniques. Types of Costs, Lifecycle Costs, Budgets, Break Even Analysis, Capital Budgeting. Application of linear Programming. Investment Analysis- NPV. ROI, IRR, Payback Period. Depreciation. Time Value of Money (present and future worth of cash flows).

Business Forecasting- Elementary techniques. Statements- Cash Flows, Financial. Case Study Method. Nature and Characteristics of Indian Economy (brief and elementary introduction). Privatization - meaning, merits. and demerits. Globalisation of Indian economy- merits and demerits. WTO and TRIPs agreements.

TEXT AND REFERENCE BOOKS:

1. Alfred William Stonier, D. C. Hague, *A text book of Economic Theory*. 5th edition, Longman Higher Education. 1980.
2. K. K. Dewett, M. H. Navalur, *Modem EconomicTheory*, S. Chand, 2006.
3. H. L. Ahuja, *Modern Microeconomic: Theory and Applications*, S. Chand. 2017.
4. N. Gregory Mankiw, *Principles of Economics*, 7th edition, South-Western College Publishing.2013.
5. Ruddar Dutt & K. P. M. Sundhram, *Indian Economy*, S. Chand, 2004.
6. V. Mote, S. Paul, G. Gupta, *Managerial. Economics*, McGraw Hill Education. 2017.
7. Saroj Pareek, *Text book of Business Economics*, Neha Publishers and Distributors. 2013.
8. William McDonough and Michael Braungart, *Cradle to Cradle Remaking the Way We Make Things*. North Point Press, New York, 2002.
9. Sustainable Development Challenges, *World Economic and Social Survey*. United Nations Publication, 2013.

CO-PO Articulation Matrix: Economics for Engineer Course (HSMC302-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Outline the principles of economics in general and economics in Indian context particularly for public sector agencies and private sector businesses. (LOTS: L1: Remember).	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2. Discuss concepts related to economics in general and particularly relevant to Indian scenario (LOTS: L2: Understand)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3. Apply the principles of economics for solving problems related to Engineering sector. . (LOTS: L3: Apply)	2	2	2	2	2	-	-	-	-	-	-	-	-	-	-
CO4. Carry out benefit/cost, life cycle and breakeven analyses on one or more economic alternatives. (HOTS: L4: Analyse).	3	2	2	3	3	-	-	-	-	-	-	-	-	-	-
CO5. Judge the issues and challenges of sustainable development. HOTS: L5: (Evaluate)	3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
Level of Attainment:															

INTERNET OF THINGS (IOT)

PCC-ECE302-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Communication

Sr. No.	Course outcomes At end of the semester: **Student will be able to**	RBT Level
CO1	**Outline** the general concepts and terminology related to internet of Things and applications.	LOTS:L1 (Remember)
CO2	**Explain** various protocols used in IOT.	LOTS: L2 (Understand)
CO3	**Identify** different types of devices and software used in IoT.	HOTS: H4 (Analyse)
CO4	**Compare** various available technologies (sensors, communication methods etc.) to design IoT based system	HOTS: H5 (Evaluate)
CO5	**Propose** IoT based system for real world problems.	HOTS: H6 (Create)

Course Contents

UNIT- I

Internet of Things: an overview :Internet of Things definition evolution, IoT architectures, Resource management, IoT data management and analytics, Communication protocols, Internet of Things applications, Security, Identity management and authentication, Privacy, Standardization and regulatory limitations

Open source semantic web infrastructure for managing IoT resources in the Cloud :Background related work, Open IoT architecture for IoT/cloud convergence, Scheduling process and IoT services lifecycle, Scheduling and resource management, Validating applications and use cases, Future research directions

Device/Cloud collaboration framework for intelligence applications: Background and related work, Device/cloud collaboration framework, Applications of device/cloud collaboration, Future work

UNIT- II

Stream processing in IoT: foundations, state-of-the-art, and future directions: The foundations of stream processing in IoT, Continuous Logic Processing System. Challenges and future directions

A framework for distributed data analysis for IoT: Preliminaries, Anomaly detection. Problem statement and definitions, Distributed anomaly detection, Efficient incremental local modeling

UNIT- III

Security and privacy in the Internet of Things: Concepts. IoT security overview, Security frameworks for IoT, Privacy in IoT networks

Internet of Things—robustness and reliability: IoT characteristics and reliability issues. Addressing reliability

Governing Internet of Things: issues, approaches, and new paradigms: Background and related work, IoT governance, Future research directions

UNIT- IV

Applied Internet of Things: Scenario, Architecture overview. Sensors, The gateway, Data transmission

Internet of Vehicles and applications: Basics of IoT Characteristics and challenges. Enabling technologies, Applications

TEXT BOOKS AND REFERENCE BOOKS:

1. Internet of Things, Principles and Paradigms; Rajkumar Buyya. Elsevier.
2. The Internet of Things: From RFID to the Next-Generation Pervasive Networked Lu Yan. Yan Zhang. Laurence T. Yang. Huansheng Ning.
3. Internet of Things (A Hands-on-Approach), Vijay Madisetti , Arshdeep Bahga.
4. Designing the Internet of Things, Adrian McEwen (Author). Hakim Cassimally.
5. Computer Networks; By: Tanenbaum, Andrew S: Pearson Education Pte. Ltd., Delhi, 4th Edition
6. Data and Computer Communications; By: Stallings. William: Pearson Education Pvt. Ltd.. Delhi, 6th Edition.
7. Cloud Computing Bible, Barrie Sosinsky, Wiley-India. 2010CO-PO Articulation Matrix

CO-PO Articulation Matrix: INTERNET OF THINGS (IOT) (PCC-ECE302-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Outline the general concepts and terminology related to internet of Things and applications LOTS:L1 (Remember)	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO2 Explain various protocols used in IOT LOTS: L2 (Understand)	3	3	2	2	3	3	2	1	3	2	2	2	3	3	2
CO3 Identify different types of devices and software used in IoT HOTS: H4 (Analyse)	3	3	3	2	3	3	2	2	2	3	3	2	3	3	3
CO4 Compare various available technologies (sensors, communication methods etc.) to design IoT based system HOTS: H5 (Evaluate)	3	3	3	2	3	3		2	3	3	3	2	3	3	3
CO5 Propose IoT based system for real world problems HOTS: H6 (Create)	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3
Level of Attainment:															

VLSI DESIGN

PCC-ECE304-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Digital Electronics

Sr. No.	Course outcomes At end of the semester: Student will be able to	RBT Level
CO1	**Remember** the overview of the digital IC design techniques.	LOTS: L1 (Remember)
CO2	**Understand** the characteristics of CMOS inverter.	LOTS: L2 (Understand)
CO3	**Apply** the basic concepts of CMOS for digital IC design.	LOTS: L3 (Apply)
CO4	**Analyze** the static and dynamic characteristics of CMOS circuits.	HOTS: L4 (Analyze)
CO5	**Evaluate** the performance of CMOS circuits.	HOTS: L5 (Evaluate)
CO6	**Design and implementation** of combinational and sequential circuits.	HOTS: L6 (Create)

Course Contents

UNIT- I

Introduction: Brief history, MOS transistors, CMOS logic, overview of VLSI design methodologies, VLSI design flow, design hierarchy, concepts of regularity, modularity, and locality, VLSI design styles, design quality, packaging technology. Logic design, circuit design, physical design. MOS Transistor Theory: Introduction to the metal oxide semiconductor (MOS) structure, Long channel I-V characteristics, C-V characteristics, non-linear I-V effects, DC transfer characteristics.

UNIT- II

Introduction to ASIC and SOC: Overview of ASIC flow, Logic synthesis, static timing analysis, Design partitioning. CMOS fabrication Process Technology: Fabrication process flow- basic steps, the CMOS n

Well process, layout design rules. stick diagram, layout design, DRC. circuit extraction, manufacturing issues, Latch-up.

UNIT- III

Static Load MOS Inverters Transfer Characteristics: Pseudo nMOS. saturated load, more saturated, enhancement load, depletion load, CMOS inverter-DC characteristics. switching. switching characteristics, delay models, gate delays. power dissipation-static, dynamic, short circuit. total power, charge sharing. Combination CMOS Logic Circuits design and structures: inverter. NAND. NOR, complex logic circuits, CMOS transmission gates, pass transistor logic. ratioed logic. dynamic logic, C^2MOS logic, CMOS domino logic, NP domino logic, cascade voltage switch logic.

UNIT- IV

Sequential CMOS Logic Circuits and Structures: Latches and registers. system timing. Setup time and hold time. singal phase memory structure. two phase clocking. two phase memory structure, two phase logic. Memories elements: Memory Design. SRAM. DRAM. subsystem case studies. CMOS system design example-microprocessor, microcontroller.

TEXT BOOKS AND REFERENCE BOOKS:

1. N. H. E. Weste and C. Harris. "Principles of CMOS VLSI Design: A System Perspective, 3rd Edition, Pearson Education 2007.
2. N. H. E. Weste and C. Harris. "Principles of CMOS VLSI Design: A Circuit and System Perspective, 2nd Edition, Pearson Education 2000.
3. J. Rabaey, A. Chandrakasan and B. Nikolic, Digital Integrated Circuits: A Design Perspective, 2nd Edition, Prentice Hall 2004.
4. Digital Design Principles and Practices, John F. Wakerly, 4th Edition, Pearson Education, 2008.
5. Fundamentals of digital logic with VHDL design / Stephen Brown, Zvonko Vranesic. – 3rd ed., Published by McGraw-Hill, 2009
6. Fundamentals of digital logic with Verilog design / Stephen Brown, Zvonko Vranesic. – 3rd ed., Published by McGraw-Hill, 2009

CO-PO Articulation Matrix of VLSI DESIGN (PCC-ECE304-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Remember the overview of the digital IC design techniques. **LOTS: L1 (Remember)**	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2 Understand the characteristics of CMOS inverter. **LOTS: L2 (Understand)**	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3 Apply the basic concepts of CMOS for digital IC design. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4 Analyze the static and dynamic characteristics of CMOS circuits. **HOTS: L4 (Analyze)**	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5 Evaluate the performance of CMOS circuits. **HOTS: L5 (Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6 Design and implementation of combinational and sequential circuits. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
Level of Attainment:															

LINEAR INTEGRATED CIRCUITS & APPLICATIONS

(PCC-ECE306-T)

General Course Information

Course Credits: 3 Type: ESC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog electronics

Sr. No.	Course outcomes At end of the semester: Student will be able to	RBT Level
CO-1	**Describe** the IC 741 operational amplifier and its characteristics.	LOTS: L1 (Describe)
CO-2	**Understand** basic parameters related to Op-Amp which can be used for designing low power devices.	LOTS: L2 (Understand)
CO-3	**Demonstrate** the working principle of various data converters.	LOTS: L3 (Demonstrate)
CO-4	**Analyse** various linear and non-linear applications using Op-Amp.	HOTS: L4 (Analyse)
CO-5	**Design** low noise active filters that will improve signal quality.	HOTS: L5 (Design)

Course Contents

UNIT- I

Introduction: Block diagram representation of a typical Op-Amp. Op-Amp equivalent circuit and its analysis. Types and development of integrated circuits. IC package types. Device Identification, Power supplies for ICs.

Interpretation of Data Sheets and characteristics of an Op-Amp: Interpretation of data sheets. Ideal Op-Amp and its equivalent circuit Ideal voltage transfer curve, open loop op-amp configurations.

An Op-Amp with Negative Feedback: Block diagram representation of feedback configurations. Voltage series feedback amplifier. Voltage shunt feedback amplifier. differential amplifiers.

UNIT- II

The Practical Op-Amp: Input Offset Voltage. Input Bias Current. Input Offset Current. Output Offset Voltage. Thermal Drift. Effect of Variation in Power Supply Voltages on Offset Voltage. Common Mode Configuration and CMRR

Frequency Response of an Op-Amp: Open Loop Response. Close Loop Response. Input and Output Impedances. Effect of Finite Gain Bandwidth Product. Slew Rate.

Linear Applications: DC and AC Amplifier. Peaking Amplifier. Summing, Scaling And Averaging Amplifiers. Instrumentation Amplifier. Voltage to Current Converter. Current to Voltage Converter. Difference Amplifier. Integrator, Differentiator. very high input impedance circuit.

UNIT- III

Active Filters and Oscillators: Transfer Function. Active Filters. First Order LP & HP Butterworth Filters. Second Order LP & HP Butterworth Filters. Higher Order Filters. Band Pass Filters. Band Rejection Filters. Oscillators: Phase Shift. Wein Bridge Oscillator. quadrature oscillator. Square Wave Generator. Triangular Wave Generator. saw tooth wave generator. Voltage Controlled Oscillator.

UNIT- IV

Non-Linear Circuits: Voltage Comparator. Zero Crossing Defector. Schmitt Trigger. Peak Detector. Sample and Hold Circuit. Voltage to Frequency and Frequency to Voltage Converter, ADC and DAC. clippers and clampers. absolute value output circuit.

Specialized IC Application: Switched Capacitor Filter. 555 Timer: as Monostable Multivibrator. Astable Multivibrator. Phase-Locked Loops. Voltage Regulators: Fixed and Adjustable Voltage Regulator. power amplifiers. Switching Regulators.

TEXT AND REFERENCE BOOKS:

1. Ramakant A. Gayakwad. Op-Amps and linear integrated circuits. 4th edition. Pearson.
2. Bruce Carter and Ron Mancini. Op Amps for Everyone. 5th edition. Elsevier.
3. Linear Integrated Circuits. D.Roy Choudhary & S. Jain.
4. Sergio Franco. Design with operational amplifiers and analog integrated circuits. 3rd edition. McGraw Hill.

CO-PO Articulation Matrix of LINEAR INTEGRATED CIRCUITS & APPLICATIONS (PCC-ECE306-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Describe** the IC 741 operational amplifier and its characteristics. **LOTS: L1 (Describe)**	3	2	2	3	2	2	1	1	2	2	3	2	3	2	2
CO2. **Understand** basic parameters related to Op-Amp which can be used for designing low power devices. **LOTS: L2 (Understand)**	3	3	3	2	3	3	2	2	3	3	3	3	3	3	3
CO3. **Demonstrate** the working principle of various data converters. **LOTS: L3 (Demonstrate)**	3	3	3	2	3	3	2	2	3	2	2	2	3	2	2
CO4. **Analyse** various linear and non-linear applications using Op-Amp. **HOTS: L4 (Analyse)**	3	3	3	3	3	3	3	2	3	3	3	3	3	3	3
CO5. **Design** low noise active filters that will improve signal quality. **HOTS: L5 (Design)**	3	3	3	2	3	3	2	2	3	2	3	3	3	3	3
Level of Attainment:															

INTERNET OF THINGS (IOT) LAB

PCC-ECE302-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexure I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basics of Arduino, Basic Electronics

Sr. No.	**Course Outcomes** **At end of the semester, Student will be able to**	**RBT Level**
CO1	**Demonstrate** the concepts of IoT.	LOTS: L2 (Understand)
CO2	**Modify** the programs of Arduino.	LOTS: L3 (Apply)
CO3	**Point out** the need of Devices, Gateways and Data Management for an IOT based circuit.	HOTS: L4 (Analyse)
CO4	**Test** different technologies for an IoT based circuit and compare them.	HOTS: L5 (Evaluate)
CO5	**Design** IoT based circuits to resolve real world problems.	HOTS: L6 (Create)

LIST OF EXPERIMENTS

1. Design of digital dc voltmeter and ammeter using Arduino.
2. Design of digital ac voltmeter and ammeter using Arduino.
3. Design of digital frequency meter using Arduino.
4. Measurement of power and energy using Arduino.
5. Measurement of phase shift and power factor using Arduino.
6. Implementation of over current relay using Arduino.
7. Over/under voltage protection of home appliances using Arduino.
8. Traffic signal control using Arduino.
9. Railway gate control by stepper motors using Arduino.
10. Direction and speed control of DC motor using Arduino.
11. Hands on experience on Node MCU board (installation, install ESP8266 board in Arduino IDE, flashing Node MCU firmware on the ESP8266).
12. To control LED using IoT on Node MCU board.
13. To study PIR Motion Sensor using Node MCU board.
14. To study web server with Arduino IDE.
15. To publish Temperature Reading using ADC.
16. To study Weather Forecaster.
17. To study Door Status Monitor.
18. To study Servo motor control using Node CU board.
19. To study RGB Color Picker using Color Sensor.
20. Hands on experience on Raspberry Pi.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of INTERNET OF THINGS (IOT) LAB (PCC-ECE302-P)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Demonstrate the concepts of IoT. **LOTS: L2 (Understand)**	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO2 Modify the programs of Arduino. **LOTS: L3 (Apply)**	3	3	2	2	3	3	2	1	3	2	2	2	3	3	2
CO3 Point out the need of Devices. Gateways and Data Management for an IOT based circuit. **HOTS: L4 (Analyse)**	3	3	3	2	3	3	2	2	2	3	3	2	3	3	3
CO4 Test different technologies for an IoT based circuit and compare them. **HOTS: L5 (Evaluate)**	3	3	3	2	3	3	-	2	3	3	3	2	3	3	3
CO5 Design IoT based circuits to resolve real world problems. **HOTS: L6 (Create)**	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3
Level of attainments:															

VLSI DESIGN LAB

PCC-ECE304-P

General Course Information

Course Credits: 2 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 4	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexure I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

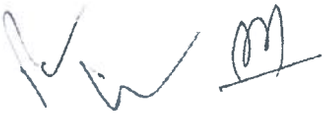
Pre-requisites: Basic of Digital Electronics

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	Apply theoretical knowledge of CMOS technology and its applications for VLSI design.	LOTS: L3 (Apply)
CO2	Analyze and evaluate the VLSI circuit design techniques practically.	HOTS: L4 (Analyze)
CO3	Integrate the importance of CAD tools in VLSI system design process and design the static and dynamic CMOS circuits.	HOTS: L6 (Create)
CO4	Create and evaluate the performance of CMOS circuits.	HOTS: L6 (Create)
CO5	Demonstrate the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To plot the output characteristics and transfer characteristics of an n-channel and p-channel MOSFET.
2. To design and plot the static (VTC) and dynamic characteristics of digital CMOS inverter.
3. To design and plot the characteristics of 2-input NAND and NOR CMOS digital logic gate.
4. To design and plot the characteristics of 2-input XOR CMOS digital logic gate.
5. To design and plot the characteristics of 2x1 digital multiplexer using pass transistor logic.
6. To design and plot the characteristics of a positive and negative latch based on multiplexers.
7. To design and plot the characteristics of a master slave positive and negative edge triggered flip-flop based on multiplexers.
8. To design and plot the characteristics of a CMOS 1-bit full adder.
9. To design and plot the characteristics of a CMOS Non-Overlapping two phase Clock.
10. To design and plot the characteristics of a CMOS comparator.
11. To design and plot the characteristics of a CMOS SRAM Cell.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 12) in the group of two-three students before the semester ends.



CO-PO Articulation Matrix of VLSI DESIGN LAB (PCC-ECE304-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply theoretical knowledge of CMOS technology and its applications for VLSI design. LOTS: L3 (Apply)	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2 Analyze and evaluate the VLSI circuit design techniques practically. HOTS: L4 (Analyze)	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3 Integrate the importance of CAD tools in VLSI system design process and design the static and dynamic CMOS circuits. HOTS: L6 (Create)	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4 Create and evaluate the performance of CMOS circuits. HOTS: L6 (Create)	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5 Demonstrate the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. LOTS: L3 (Apply)	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of attainments:															

LINEAR INTEGRATED CIRCUITS & APPLICATIONS LAB

(PCC-ECE306-P)

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic of Analog Electronics

Sr. No.	**Course Outcomes:** **At the end of the semester, students will be able:**	**RBT Level**
CO 1	To **describe** linear integrated circuits and their application using Op-Amp IC-741.	LOTS: L1 (Describe)

CO 2	To **understand** analog circuits for practical applications using Op-Amp 741.	LOTS: L2 (Understand)
CO 3	To **compare** operational amplifier circuits using PSPICE.	HOTS: H1 (Compare)
CO 4	To **analyze** multivibrators using IC555.	LOTS: L3 (Analyze)
CO 5	To **design** operational amplifier basedoscillators and comparators.	HOTS: H3 (Design)

LIST OF EXPERIMENTS

1. Design and simulate the inverting amplifier circuit using PSPICE.
2. Design and simulate the non-inverting amplifier circuit using PSPICE.
3. Design and simulate summing amplifier circuit using PSPICE.
4. Design and simulate the differential amplifier circuit using PSPICE.
5. Design and simulate the inverting averaging circuit using PSPICE.
6. Design and simulate PSPICE model of second order low pass Butterworth filter
7. Design and simulate PSPICE model of second order high pass Butterworth filter.
8. Design and simulate PSPICE model of square wave generator.
9. Design and simulate Differentiator circuit using PSPICE.
10. Design and simulate Integrator circuit using PSPICE.
11. Design and simulate oscillators and comparators circuit using PSPICE.
12. Simple project (Any topic related to the scope of the course).

NOTE: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of LINEAR INTEGRATED CIRCUITS & APPLICATIONS LAB (PCC-ECE306-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 To **describe** linear integrated circuits and their application using Op-Amp IC-741. **LOTS: L1 (Describe)**	2	2	1	3	2	2	1	1	2	2	2	3	3	2	2
CO2 To **understand** analog circuits for practical applications using Op-Amp 741. **LOTS: L2 (Understand)**	3	3	3	2	2	2	1	1	3	2	2	2	3	2	2
CO3 To **compare** operational amplifier circuits using PSPICE. **HOTS: H1 (Compare)**	3	2	3	3	2	2	1	1	3	3	2	2	3	2	2
CO4 To **analyze** multivibrators using IC555. **LOTS: L3 (Analyze)**	2	3	3	3	3	3	2	1	2	1	1	2	2	1	2
CO5 To **design** operational amplifier based oscillators and comparators. **HOTS: H3 (Design)**	3	3	3	2	2	2	1	1	2	2	2	1	2	1	2
Level of attainments:															

DIGITAL SIGNAL PROCESSING

PCC-ECE401-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic of Signal and System

Sr. No.	Course Outcomes At end of the semester, Student will be able to	RBT Level
CO1	Define and describe the terminology related to digital signals, digital systems, and processing of digital signals.	LOTS: L1 (Remember)
CO2	Explain the principles and applications of digital signal processing, including frequency domain analysis of discrete-time systems and applications of digital filters.	LOTS: L2 (Understand)
CO3	Apply the knowledge gained to solve problems in processing of digital signals using digital filters and analyzing signal spectra.	LOTS: L3 (Apply)
CO4	Analyze the performance of digital signal processing systems and techniques.	HOTS: L4 (Analyze)
CO5	Design and implement digital signal processing techniques or systems, using their understanding of the underlying principles and their skills in simulation tools.	HOTS: L6 (Create)

Course Contents

UNIT-1

INTRODUCTION: Basic elements of digital signal processing system. Advantages of digital over analog signal processing. Concept of frequency in discrete time signals. Discrete time signals and systems. Analysis of discrete time systems: techniques, convolution sum and its properties, interconnection of LTI systems, causality

and stability of LTI systems, Characterization of discrete time systems by difference equation and its solution. Impulse response of LTI systems. Correlation of discrete time signals: Cross-correlation, auto-correlation, properties of cross-correlation and auto-correlation

DISCRETE FOURIER TRANSFORM (DFT): Computation of DFT and IDFT, DFT as a Linear Transformation, Properties of DFT. Use of DFT in linear filtering. Filtering of long data sequences: overlap-add method, overlap-save method.

UNIT-II

FAST FOURIER TRANSFORM (FFT): Fast Fourier Transform, Radix-2FFT Algorithms: decimation-in-time, decimation-in-frequency FFT algorithm & their inverse.

IMPLEMENTATION OF DISCRETE-TIME SYSTEMS: Structures for realization of discrete-time systems, Structures for FIR systems: direct form structures, cascade form structures, linear-phase structure. Structures for IIR systems: direct form structures I & II, cascade form structures, parallel form structures.

UNIT –III

FIR & IIR FILTER DESIGN: Advantages and disadvantages of digital filters, Difference between FIR and IIR filters. Design of FIR filters: importance of linear phase response, condition for filter to have linear-phase response, types of linear-phase filters, filter specifications, impulse response of ideal low pass filter, Gibb's phenomenon, windowing method for design of linear phase FIR filter.

Steps to design IIR filters from analog filters & mapping rules: Conversion of analog system to digital system by: Approximation of derivatives, Impulse-invariant method, bilinear transformation method.

UNIT-IV

MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction to Multirate digital signal processing, interpolation by factor I, decimation by factor D, sampling rate conversion by rational factor, multistage implementation of sampling rate conversion. Applications of Multirate Signal Processing.

TEXT BOOKS AND REFERENCE BOOKS:

1. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing, Principles, Algorithms, & Applications", Prentice –Hall India.
2. T.K. Rawat, "Digital Signal Processing" Oxford University Press.
3. S. Mitra, "Digital Signal Processing- A computer-based approach" TMH.
4. L. R. Rabiner& B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall India.
5. A. V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete-Time Signal Processing", Prentice Hall India.
6. A. V. Oppenheim, R. W. Schafer, "Digital Signal Processing", Prentice Hall India.
7. Salivahanan, Vallavaraj and Gnanapriya, "Digital Signal Processing", TMH.

CO-PO Articulation Matrix of DIGITAL SIGNAL PROCESSING (PCC-ECE401-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Define** and describe the terminology related to digital signals, digital systems, and processing of digital signals. **LOTS: L1 (Remember)**	3	3	2	2	1	1	-	-	-	-	-	3	2	2	2
CO2 **Explain** the principles and applications of digital signal processing, including frequency domain analysis of discrete-time systems and applications of digital filters .**LOTS: L2 (Understand)**	3	3	2	2	1	1	-	-	-	-	-	2	2	2	3
CO3 **Apply** the knowledge gained to solve problems in processing of digital signals using digital filters and analyzing signal spectra. **LOTS: L3 (Apply)**	3	3	2	2	1	1	-	-	-	-	-	2	3	3	3
CO4 **Analyse** the performance of digital signal processing systems and techniques. **HOTS: L4 (Analyze)**	3	3	3	2	2	2	-	-	-	1	-	3	3	3	3
CO5 **Design** and implement digital signal processing techniques or systems, using their understanding of the underlying principles and their skills in simulation tools. **HOTS: L6 (Create)**	3	3	3	2	2	2	-	-	-	1	-	3	3	3	3
Level of attainments:															

ADVANCED MOBILE COMMUNICATION

PCC-ECE403-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching Schedule L T P: 3-00 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Communication System

Sr. No.	Course Outcomes: **At the end of the semester, Students will be able to**	RBT Level
CO1	**Define** the significance of communication in daily life.	LOTS: L1 (Remember)
CO2	**Explain** the evolution of mobile communication and technologies over the years.	LOTS: L2 (Understand)
CO3	**Use** the theory of communication in different scenario.	LOTS: L3 (Apply)
CO4	**Compare** the speed of 3G/4G/LTE and 5G/6G in cellular communication.	HOTS: L4 (Analyze)
CO5	**Evaluate** various types of applications of 3G, 4G, 5G, 6G and advanced techniques in cellular communications.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

Mobile Communication Overview: Evolution from 1G to 5G, Analog Voice System, Digital Radio System in 2G, 3G, 4G, LTE features and architecture, introduction to 5G communication, architecture, New Radio, massive MIMO, potentials and applications of 5G, usage scenarios, Spectrum for 5G – 5G deployment, Challenges and Applications.

ADVANCED MOBILE COMMUNICATION

PCC-ECE403 -T

UNIT-II

Enhanced mobile broadband(eMBB), ultra reliable low latency communication(uRLLC), massive machine type communication(MMTC), D2D communication, V2X communication, spectrum for 5G, spectrum access/sharing, millimeter wave communication.

UNIT-III

OFDM, Non-Orthogonal Multiple Access (NOMA), carrier aggregation.5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)-Radio Protocol Architecture -User Plane Protocols, Control Plane Protocols - Network Slicing- RAN virtualization, 5G deployment challenges, dynamic spectrum access.

UNIT-IV

6G current research & initiatives, 6G Opportunities & applications, 6G networks, 6G security, 6G challenges.

TEXT BOOKS AND REFERENCE BOOKS:

1. Mobile Communication by Jochen Schiller, Financial Times/Imprint of pearson
2. 6G: The Road to the Future Wireless Technologies 2030, Ramjee Prasad, River Publishers Series.
3. Wireless Communications Systems Architecture Transceiver Design and DSP Towards 6G, Khaled Salah Mohamed, Springer.
4. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
5. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
6. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
7. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
8. Robert W. Heath Jr, Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
9. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

ADVANCED MOBILE COMMUNICATION

PCC-ECE403 - T

CO-PO Articulation Matrix of ADVANCED MOBILE COMMUNICATION (PCC-ECE403 –T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Define** the significance of communication in daily life. **LOTS: L1 (Remember)**	3	2	2	1	-	-	-	-	-	1	1	3	3	2	3
CO2 **Explain** the evolution of mobile communication & technologies over the years. **LOTS: L2 (Understand)**	3	2	2	1	-	1	-	-	-	1	1	3	3	3	3
CO3 Use the theory of communication in different scenario. **LOTS: L3 (Apply)**	3	2	3	1	-	-	-	-	-	1	2	3	3	3	3
CO4 **Compare** the speed of 3G 4G/LTE and 5G 6G in cellular communication. **HOTS: L4 (Analyze)**	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
CO5 **Evaluate** various types of applications of 3G. 4G. 5G. 6G and advanced techniques in cellular communications. **HOTS: L5 (Evaluate)**	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
Level of attainments:															

DIGITAL SYSTEM DESIGN

PCC-ECE405-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic of Digital Electronics

Sr. No.	Course Outcomes At end of the semester, Student will be able to	RBT Level
CO1	**Define** and describe the use of HDL & appropriate EDA tools for digital logic design and simulation.	LOTS: L1 (Remember)
CO2	**Understand** digital logic to design digital system.	LOTS: L2 (Understand)
CO3	**Apply** the concepts of combinational logic and sequential logic circuits to build the digital systems.	LOTS: L3 (Apply)
CO4	**Analyze** the modular combinational circuits with MUX/DEMUX, Decoder and Encoder.	HOTS: L4 (Analyze)
CO5	**Evaluate** and compare performance of combinational circuits and synchronous sequential logic circuits.	HOTS: L5 (Evaluate)
CO6	**Create** the HDL models & use appropriate EDA tools for digital logic design and simulation, synthesis.	HOTS: L6 (Create)

DIGITAL SYSTEM DESIGN

PCC-ECE405-T

Course Contents

UNIT- I

Digital Design: Introduction, digital devices, Electronics aspects of Digital design, software aspects of digital design, integrated circuits, VLSI Design flow: Design entry: Schematic, HDL, HDL based design, VHDL, program structure, data types and objects, operators, Dataflow, Behavioral and Structural Modeling and elements, delay models, Synthesis and Simulation, test bench, VHDL constructs for combinational and sequential circuits.

UNIT- II

Verilog HDL: Overview of Digital Design with Verilog HDL, program structure, Hierarchical Modeling Concepts, Basic Concepts, Modules and Ports, Gate-Level Modeling, Dataflow Modeling, Behavioral Modeling, Tasks and Functions, Useful Modeling Techniques, Compiler directives, system tasks and functions.

UNIT- III

Combinational logic design practices in VHDL and Verilog: Decoder, Encoder, Multiplexers, Comparators, three state devices, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter, combinational multipliers and ALU.

Sequential logic design practices in VHDL and Verilog: Latches and flip flops, State machine analysis, state machine design, design state machine using state diagrams, Design of synchronous FSM, Algorithmic State Machines charts, counters, shift registers, sequential circuit design with VHDL and Verilog.

UNIT- IV

Concept of Programmable logic devices: Memory-ROM, RAM-static, dynamic, PLAs, PALs, CPLDs and FPGA, Design implementation using CPLDs and FPGAs, Computer model, processor and memory model, data path part, control part Adding CPU Verilog description, CPU design and test.

TEXT AND REFERENCE BOOKS:

1. Digital Design Principles and Practices, John F. Wakerly, 4th Edition, Pearson Education, 2008.
2. A VHDL Primmer: Bhasker; Prentice Hall 1995.
3. VHDL-Analysis & Modelling of Digital Systems: Navabi Z; McGraw Hill.
4. Verilog Digital System Design-RT level Synthesis, Testbench and Verification, Z Navabi, 2nd Edition. Copyright © 2006 by The McGraw-Hill Publishing Companies
5. Verilog HDL-A Guide to Digital Design and Synthesis, Samir Palnitkar, SunSoft Press 1996
6. The Verilog® Hardware Description Language, Donald E. Thomas & Philip R. Moorby, Fifth Edition. ©2002 Kluwer Academic Publishers
7. Introduction to Digital Systems,Ercegovac, Lang & Moreno; John Wiley (1999).
8. Fundamentals of digital logic with VHDL design / Stephen Brown, ZvonkoVranesic. – 3rd ed.. Published by McGraw-Hill, 2009
9. Fundamentals of digital logic with Verilog design / Stephen Brown, ZvonkoVranesic. – 3rd ed.. Published by McGraw-Hill, 2009
10. Digital Design with an Introduction to Verilog HDL, M Morris Mano, Michael D. Ciletti, 5th Edition,Pearson, 2017.
11. Digital System Design with FPGA-Implementation using Verilog and VHDL, Cen Unsalan& Bora Tar, Copyright © 2017 by McGraw-Hill Education
12. Digital Design using Field Programmable Gate array by P.K.Chan,Samihamourad, Printice Hall Series
13. Digital System Designs and Practices: Using Verilog Hdland FPGAs by Ming Bo lin, Wiley India Edition.

CO-PO Articulation Matrix of DIGITAL SYSTEM DESIGN (PCC-ECE405-T)															
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Define and describe the use of HDL & appropriate EDA tools for digital logic design and simulation. LOTS: L1 (Remember)	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2	Understand digital logic to design digital system. LOTS: L2 (Understand)	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3	Apply the concepts of combinational logic and sequential logic circuits to build the digital systems. LOTS: L3 (Apply)	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	Analyze the modular combinational circuits with MUX/DEMUX, Decoder and Encoder. HOTS: L4 (Analyze)	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5	Evaluate and compare performance of combinational circuits and synchronous sequential logic circuits. HOTS: L5 (Evaluate)	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6	Create the HDL models & use appropriate EDA tools for digital logic design and simulation. synthesis. HOTS: L6 (Create)	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
	Level of attainments:															

DIGITAL SIGNAL PROCESSING LAB

PCC-ECE401-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexure I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic of MATLAB, basic concepts of signal and system

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	Apply their knowledge of MATLAB programming to design and implement digital signal processing algorithms and systems, including filtering, signal generation, and spectrum analysis.	LOTS: L3 (Apply)
CO2	Analyze and evaluate the performance of digital signal processing systems and algorithms using MATLAB simulation tools, including frequency response, stability, and noise characteristics.	HOTS: L4 (Analyze)
CO3	Design digital filters and other digital signal processing systems using their understanding of the underlying principles and their MATLAB skills.	HOTS: L6 (Create)

DIGITAL SIGNAL PROCESSING LAB

PCC-ECE401-P

CO4	**Create** written records for the given assignments with problem definition, design of solution and conclusion.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To represent basic signals (Unit step, unit impulse. ramp, exponential, sine and cosine) in MATLAB.
2. To generate triangular, saw tooth and square waveform using MATLAB program.
3. To develop program for discrete convolution.
4. To develop program for discrete correlation.
5. To develop program for sampling of a continuous time signal with different sampling frequency in order to study aliasing effect.
6. To develop a program to determine the impulse response of a system for which input sequences and output sequences are given.
7. To design Butterworth IIR filters (low-pass, high pass. band-pass, band-stop).
8. To design digital FIR filters using windows technique (Rectangular window, Blackman window, Hamming window, Hanning window).
9. To plot the magnitude and phase spectrum of a signal using DFT.
10. To perform interpolation and decimation using MATLAB.
11. To develop program for computing linear and circular convolution.
12. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
13. To develop program for stability test using MATLAB.
14. To develop a program for computing inverse Z-transform of a rational transfer function.
15. To develop a program for computing parallel realization values of IIR digital filter.
16. To develop a program for computing cascade realization values of IIR digital filter.
17. To develop a program for noise reduction in audio signals using digital filters.
18. To develop a program for image sharpening and enhancement using Discrete Cosine Transform (DCT).
19. To develop a program for design and implementation of Finite Impulse Response (FIR) Filters for signal processing.
20. To develop a program for analysis of speech signals using Linear Predictive Coding (LPC) techniques.
21. To develop a program for spectrum analysis of signals using Fast Fourier Transform.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 18 to Ex No. 22) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of DIGITAL SIGNAL PROCESSING LAB (PCC-ECE401-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply their knowledge of MATLAB programming to design and implement digital signal processing algorithms and systems, including filtering, signal generation, and spectrum analysis. LOTS: L3 (Apply)	3	3	3	2	3	1	-	-	-	-	-	2	3	3	2
CO2 Analyze and evaluate the performance of digital signal processing systems and algorithms using MATLAB simulation tools. including frequency response. stability. and noise characteristics. HOTS: L4 (Analyze)	3	3	3	3	3	1	-	-	-	-	-	2	3	3	2
CO3 Design digital filters and other digital signal processing systems using their understanding of the underlying principles and their MATLAB skills. HOTS: L6 (Create)	3	3	3	3	3	1	-	-	-	-	-	2	3	3	2
CO4 Create wrote records for the given assignments with problem definition. design of solution and conclusion. HOTS: L6 (Create)	-	1	1	1	1	2	1	3	3	3	3	2	2	1	2
CO5 Demonstrate ethical practices while solving problems individually or in groups. LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	2	1	1	1
Level of attainments:															

DIGITAL SIGNAL PROCESSING LAB

PCC-ECE401-P

DIGITAL SYSTEM DESIGN LAB

PCC-ECE405-P

General Course Information

Course Credits: 2 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 4	**Course Assessment Methods: Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexure I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic of Digital Electronics

Sr. No.	**Course outcomes** **At end of the semester, Student will be able to**	**RBT Level**
CO1	**Apply** theoretical knowledge of combinational logic circuits for VLSI design.	LOTS: L3 (Apply)
CO2	**Analyze** and evaluate the modular combinational circuits with MUX/DEMUX, Decoder and Encoder.	HOTS: L4 (Analyze)
CO3	**Integrate** the combinational and synchronous sequential logic circuits to design the digital systems.	HOTS: L6 (Create)
CO4	**Create** and evaluate the performance of digital circuits and systems	HOTS: L6 (Create)

	using HDLs.	
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Familiarisation with VHDL and Verilog HDL program structure, and EDA tools.
2. Write VHDL and Verilog programs for decoder, encoder, multiplexer and seven segment decoder design in behavioural, data flow and structural modelling.
3. Write VHDL and Verilog programs for comparator design.
4. Write VHDL and Verilog programs for Adder and subtractor design in behavioural, data flow and structural modelling.
5. Write VHDL and Verilog programs for multiplier design in behavioural, data flow and structural modelling.
6. Write VHDL and Verilog programs for ALU design.
7. Write VHDL and Verilog programs for latches and flip flops design in behavioural, data flow and structural modelling.
8. Write VHDL and Verilog programs for serial adder design.
9. Write VHDL and Verilog programs for serial multiplier design.
10. Write VHDL and Verilog programs for counters design in behavioural, data flow and structural modelling.
11. Write VHDL and Verilog programs for shifters design in behavioural, data flow and structural modelling.
12. Write VHDL and Verilog programs for barrel shifter design in behavioural, data flow and structural modelling.
13. Write VHDL and Verilog programs for memory blocks.
14. Test bench writing and simulation in VHDL and Verilog.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 14) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of DIGITAL SYSTEM DESIGN LAB (PCC-ECE405-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PC6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply theoretical knowledge of combinational logic circuits for VLSI design. **LOTS: L3 (Apply)**	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2 Analyze and evaluate the modular combinational circuits with MUX DEMUX, Decoder and Encoder. **HOTS: L4 (Analyze)**	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3 Integrate the combinational and synchronous sequential logic circuits to design the digital systems. **HOTS: L6 (Create)**	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4 Create and evaluate the performance of digital circuits and systems using HDLs. **HOTS: L6 (Create)**	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5 Demonstrate the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of attainments:															

DIGITAL SYSTEM DESIGN LAB

PCC-ECE405-P

CONSUMER & INDUSTRIAL ELECTRONICS

PEC-ECE308-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic Electronics

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	**Outline** the terminology related to consumer and industrial electronics systems	LOTS: L1 (Remember)
CO2	**Understand** fundamental principles related to consumer and industrial electronics systems	LOTS: L2 (Understand)
CO3	**Apply** methods and principles to construct consumer and industrial electronics systems segments model.	LOTS: L3 (Apply)
CO4	**Analyse** various electronics systems in terms of design or performance parameters.	HOTS: L4 (Analyze)
CO5	**Design** segments of various electronics systems	HOTS: L6 (Create)

Course Contents

UNIT- I

Audio and Video Systems: Basic block diagram. Principle and working of the following: Microphone, Headphone, Hearing Aid, Loudspeaker, Equalizers and mixers, Electronic Music Synthesizer, Public Address System, Theatre Sound system, AM/FM tuners, OLED TV, TV remote control, Setop Box.

UNIT- II

Home Equipments: Basic block diagram, Principle and working of the following: Washing Machine, Air Conditioner, Refrigerator, Microwave Oven, RO system, CCTV, Mobile Phone Handset, Mobile Charger.

UNIT- III

Office Equipments: Basic block diagram, Principle and working of the following: Desktop computer, Laptop, Laser Printer, Photocopier,BAR-code Scanner and Decoder, Point of Sale terminal, Automated Teller Machines (ATMs).

UNIT- IV

In-Car Computers: Basic block diagram, Principle and working of the following: Electronic Ignition, Electronically Controlled Suspension (ECS), Antilock Braking System (ABS), Instrument Panel Displays, Ultrasonic Car Safety Belt System, Air Bag System, Vehicle Proximity Detection System, Car Navigation System.

TEXT AND REFERENCE BOOKS:

1. S.P Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd.
2. R Bali and S.P Bali, "Audio Video Systems: Principle Practice & Troubleshooting, Khanna Publication.
3. Philip Hoff, "Consumer Electronics for Engineers", Cambridge University CO-PO Articulation Matrix

CO-PO Articulation Matrix of CONSUMER & INDUSTRIAL ELECTRONICS (PEC-ECE308-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Outline the terminology related to consumer and industrial electronics systems. LOTS: L1 (Remember)	-	1	-	-	-	-	-	-	1	-	-	-	3	-	-
CO2 Understand fundamental principles related to consumer and industrial electronics systems. LOTS: L2 (Understand)	1	3	1	1	-	-	-	-	1	-	-	-	3	-	1
CO3 Apply methods and principles to construct consumer and industrial electronics systems segments model. LOTS: L3 (Apply)	2	3	2	2	1	-	-	-	1	-	-	-	3		2
CO4 Analyse various electronics systems in terms of design or performance parameters. HOTS: L4 (Analyze)	3	3	2	2	1	-	-	-	1	-	-	1	3	2	2
CO5 Design segments of various electronics systems. HOTS: L6 (Create)	3	3	3	3	2	-	-	-	2	-	-	2	3	2	3
Level of attainments:															

COMPUTER NETWORKS

PEC-ECE310-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic of Communication System

Sr. No.	**Course Outcomes:** **At end of the semester, Student will be able to**	**RBT Level**
CO1	**Describe** terminologies & basics of computer network systems.	LOTS: L1 (Remember)
CO2	**Understand** the concepts of computer network models & internet along with their addressing, protocols, specifications & security.	LOTS: L2 (Understand)
CO3	**Apply** the concepts of data communication & internet for different applications of computer networking.	LOTS: L3 (Apply)
CO4	**Analyze** the performance of various types of computer networks.	HOTS: L4 (Analyze)
CO5	**Design** basic computer network systems in a better fashion with thorough knowledge of internet working technologies.	HOTS: L6 (Create)

Course Contents

UNIT-1

Data Communication, Networks, Internet, Network Models: OSI model, TCP/IP model & protocol suite, Data rate limits, Shannon's Theorem, Circuit switched Networks, Datagram Networks, Virtual Circuit Networks, Network Topologies, Types of Networks (LAN, MAN, WAN, PAN).

UNIT-2

Physical layer interfaces (RS232/ EIA232/USB). Medium Access control (Aloha, CSMA/CD, CSMA/CA). Error Detection & correction: LRC, CRC, checksum, Hamming code, shortest path algorithm.

UNIT-3

Logical addressing. IPv4, IPv6, transition from IPv4 to IPv6, Domain Name System (DNS), Dynamic Domain name system, DNS in the internet.

Protocols-ARP, RARP, TCP, UDP, HDLC, SMTP, http.

UNIT-4

IEEE standards- 802.11, 802.15, 802.16, 802.20, 802.22.

Network securitymodel for network security, RSA algorithm, Digital Signature, e-mail security, Firewalls, VPNs, Proxy servers.

TEXT & REFERENCE BOOKS:

1. Tanenbaum Andrew S., Computer Networks, 4th edition (2nd Impression 2006), Pearson Education.
2. Stallings William, Data and Computer Communications, 7th Edition, PHI.
3. Halsall Fred, Data Communications, Computer Networks and OSI, 4th edition.
4. Stallings William, Cryptography and Network Security Principles and Practices, 4thEdition, PHI.
5. Forouzan B.A., Data Communication & Networking, 5th Edition, TMH.

CO-PO Articulation Matrix of COMPUTER NETWORKS (PEC-ECE-310-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Describe** terminologies & basics of computer network systems. **LOTS: L1 (Remember)**	3	1	2	2	--	--	--	--	--	--	1	2	3	2	1
CO2 **Understand** the concepts of computer network models & internet along with their addressing, protocols, specifications & security. **LOTS: L2 (Understand)**	3	2	3	3	2	--	--	--	--	--	2	3	3	2	2
CO3 **Apply** the concepts of data communication & internet for different applications of computer networking. **LOTS: L3 (Apply)**	2	3	2	2	3	3	1	1	2	--	2	2	2	3	3
CO4 **Analyze** the performance of various types of computer networks. **HOTS: L4 (Analyze)**	2	3	2	2	3	3	1	1	1	1	1	1	1	3	3
CO5 **Design** basic computer network systems in a better fashion with thorough knowledge of internetworking technologies. **HOTS: L6 (Create)**	2	1	3	3	3	3	3	3	3	2	3	3	1	3	3
Level of attainments:															

SATELLITE & RADAR COMMUNICATION

PEC-ECE312-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Communication Systems, Antenna and Wave Propagation

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	Outline the terminology related to Satellite and Radar Communication.	LOTS: L1 (Remember)
CO2	Understand fundamental principles related to Satellite and Radar Communication.	LOTS: L2 (Understand)
CO3	Apply methods and principles to construct Satellite and Radar Communication segments model.	LOTS: L3 (Apply)
CO4	Analyze satellite communication system and radar communication system in terms of design or performance parameters.	HOTS: L4 (Analyze)
CO5	Design segments of satellite communication system and radar communication system	HOTS: L6 (Create)

Course Contents

UNIT- I

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Orbits and Launching Methods: Introduction, Kepler's Laws, Definitions of Terms for Earth-Orbiting Satellites, Orbital Elements, Apogee and Perigee Heights, Orbit Perturbations, Inclined orbits, Geostationary Orbit.

UNIT- II

The Earth Segment: Introduction, Receive-Only Home TV Systems, outdoor unit, indoor unit for analog (FM), Master Antenna TV System, Community Antenna TV System, Transmit-Receive Earth Stations

Space Segment: Introduction, Power Supply, Attitude Control, Station Keeping, Thermal Control, TT&C Subsystem, Transponders, Antenna Subsystem

UNIT- III

INTRODUCTION TO RADAR: Radar Block Diagram & operation, Radar Frequencies, Radar development, Application of Radar, Simple form of Radar Equation, Prediction of Range performance, Minimum detectable signal, Receiver noise, Signal to Noise ratio, Transmitter Power, Pulse repetition frequency & range ambiguities, System losses, Propagation effects.

UNIT- IV

CW & MTI RADAR: The Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple Frequency CW, Radar, Delay Line Cancellors, Multiple or staggered, Pulse repetition frequencies, Range-Gated Doppler Filters, Digital Signal Processing, Other MTI delay line, Limitation of MTI performance, Non-coherent MTI, Pulse Doppler Radar, MTI from a moving platform.

TEXT AND REFERENCE BOOKS:

1. Dennis Roddy, "Satellite Communication" 4th Edition, McGraw Hill, 2009
2. Dr.D.C. Agarwal, "Satellite Communications" Khanna Publishers, 2001.
3. Skolnik, Merrill," Introduction to Radar Systems", Tata McGraw-Hill, 3rd Edition, 2001.
4. K. K. Sharma, fundamentals of Radar, Sonar and Navigation Engineering, S K Kataria& Sons.
5. M. Kulkarni, Microwave & Radar Engineering, Umesh Publications.
6. Microwave & Radar Engg, Dr. A. K. Gautam, Katson Books.

CO-PO Articulation Matrix of SATELLITE & RADAR COMMUNICATION (PEC-ECE312-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Outline the terminology related to Satellite and Radar Communication. **LOTS: L1 (Remember)**	-	1	-	-	-	-	-	-	1	-	-	-	3	-	-
CO2 Understand fundamental principles related to Satellite and Radar Communication. **LOTS: L2 (Understand)**	1	3	1	1	-	-	-	-	1	-	-	-	3	-	1
CO3 Apply methods and principles to construct Satellite and Radar Communication segments model. **LOTS: L3 (Apply)**	2	3	2	2	1	-	-	-	1	-	-	-	3	-	2
CO4 Analyze satellite communication system and radar communication system in terms of design or performance parameters. **HOTS: L4 (Analyze)**	3	3	2	2	1	-	-	-	1	-	-	1	3	2	2
CO5 Design segments of satellite communication system and radar communication system **HOTS: L6 (Create)**	3	3	3	3	2	-	-	-	2	-	-	2	3	2	3
Level of attainments:															

POWER ELECTRONICS

PEC-ECE314-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic of Analog Electronics

Sr. No.	Course Outcomes At end of the semester, Student will be able to	RBT Level
CO1	**Define** the basics operations and characteristics of power electronics devices.	LOTS: L1 (Remember)
CO2	**Use** the power electronics devices and circuits in commercial and industrial applications.	LOTS: L3 (Apply)
CO3	**Compare** the performance of various power semiconductor devices, passive components and switching circuits.	HOTS: H4 (Analyse)
CO4	**Test** power electronics circuits for troubleshooting.	HOTS: H5 (Evaluate)
CO5	**Design** the SCR controlled devices, firing and commutating circuit, inverters, choppers and drivers.	HOTS: H6 (Create)

Course Contents

UNIT-I

Power Semiconductor Devices: Role & applications of power electronics. Construction &Static V-I characteristics of Thyristors. Thyristor turn on methods, switching characteristics of Thyristor, two transistor model of Thyristor. Thyristor Protection. Series and parallel connection of Thyristor. Gate Turn-off Thyristor. Multilayer devices: Construction &characteristics of DIAC, TRIAC.

SCR Commutating Circuits: Thyristor Turn-off methods: Line commutation, Load commutation, Forced commutation, Commutating circuits, Voltage commutation, Current commutation & Pulse commutation.

UNIT-II

Converters: Principal of phase-controlled rectifiers: single phase half wave circuit with RL load, single phase half wave circuit with RL load and freewheeling diode. Single phase Full wave-controlled converters: Mid-Point and Bridge converters. Dual converter: Ideal and Practical dual converter.

UNIT-III

Inverters: Basic circuit. 120-degree mode and 180-degree mode conduction schemes. Force commutated Thyristor inverters: modified McMurray half bridge and full bridge inverters. McMurray -Bedford half bridge and bridge inverters, brief description of parallel and series inverters, current source inverter (CSI).

UNIT-IV

Choppers: Principal of Chopper operation, output voltage control techniques, step-up chopper, one, two, and four quadrant choppers. Thyristor Chopper Circuit: voltage commutated chopper, current commutated chopper and Load Commutated chopper.

Cycloconverters: Basic principle of cycloconverter operation. Types of cycloconverter: non-circulating and circulating types of cycloconverters.

TEXT BOOKS AND REFERENCE BOOKS:

1. Power Electronics: P.S Bhimra, Khanna Publication.
2. Power Electronics: MH Rashid; PHI.
3. Power Electronics and Introduction to Drives: A.K.Gupta and L.P.Singh:Dhanpat Rai.
4. Power Electronics: PC Sen; TMH.
5. Power Electronics: HC Rai; Galgotia.
6. Thyristorised Power Controllers: GK Dubey, PHI.

CO-PO Articulation Matrix of POWER ELECTRONICS (PEC-ECE314-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 **Define** the basics operations and characteristics of power electronics devices. **LOTS: L1 (Remember)**	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO2 Use the power electronics devices and circuits in commercial and industrial applications. **LOTS: L3 (Apply)**	3	3	2	2	1	3	2	-	2	2	-	3	3	2	2
CO3 **Compare** the performance of various power semiconductor devices. passive components and switching circuits. **HOTS: H4 (Analyse)**	3	3	2	2	1	3	2	-	2	2	-	3	3	2	3
CO4 **Test** power electronics circuits for troubleshooting. **HOTS: H5 (Evaluate)**	3	3	3	3	2	3	1	1	2	1	-	3	3	3	3
CO5 **Design** the SCR controlled devices. firing and commutating circuit. inverters. choppers and drivers. **HOTS: H6 (Create)**	3	3	3	3	2	3	1	1	2	1	-	3	3	3	2
Level of attainments:															

OPTICAL COMMUNICATION

PEC- ECE316-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Communication Engineering

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Describe** terminologies & basics of optical communication systems.	LOTS: L1 (Remember)
CO2	**Understand** the concepts of losses and signal impairments in optical transmission.	LOTS: L2 (Understand)
CO3	**Apply** the concepts of signal transmission & reception in optical networks.	LOTS: L3 (Apply)
CO4	**Analyze** the performance of various types of optical networks.	HOTS: L4 (Analyze)
CO5	**Design** basic Optical systems in an improved manner with thorough knowledge of optical transmission.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

INTRODUCTION: Electromagnetic spectrum used for optical communication, block diagram of optical communication system, Advantages of optical fiber communication, propagation of light inside fiber, Total internal reflection, numerical aperture, Optical fibers structures and their types.

UNIT -II

LOSSES IN OPTICAL FIBER: attenuation, scattering, absorption, fiber bend loss, dispersion, material, waveguide, polarized mode dispersion, intermodal and intramodal dispersion.

NON LINEAR EFFECTS: Kerr effect, SPM, XPM, FWM, SRS.

OPTICAL COMMUNICATION

PEC- ECE316-T

UNIT -III

OPTICAL SOURCES: Principal & working of LEDs & LASERs. Types of LEDs & LASERs.

PHOTO-DETECTORS: PIN. APD and their characteristics. Thermal noise, dark current noise. quantum noise.

UNIT -IV

OPTICAL AMPLIFIERS - EDFA. Raman amplifier. Principles of WDM networks,. Splicing. fiber couplers and connectors. FBG principal & working. Optical link design. Introduction to: SONET, fiber to home (FTTH). Radio over Fiber (RoF).

TEXT AND REFERENCE BOOKS:

1. J. Keiser. Fiber Optic communication. McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. J. Senior, Optical Fiber communications. Pearson, 3rd edition, 2009.
3. G. Agrawal. Fiber optic Communication Systems, John Wiley and sons, New York, 1997
4. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).
5. G. Agrawal. Nonlinear fiber optics. Academic Press. 2nd Ed. 1994.

OPTICAL COMMUNICATION

PEC- ECE316-T

CO-PO Articulation Matrix of Optical Communication (PEC-ECE316-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 **Describe** terminologies & basics of optical communication systems. LOTS: L1 (Remember).	3	1	1	2	--	--	--	--	--	--	1	1	3	2	2
CO2 **Understand** the concepts of losses and signal impairments in optical transmission.LOTS: L2(understand).	3	2	3	3	2	--	--	--	--	--	2	3	3	2	2
CO3 **Apply** the concepts of signal transmission and reception in optical networks.LOTS: L3(Apply).	2	3	2	2	3	3	1	1	2	--	2	2	2	3	3
CO4 **Analyze** the performance of various types of optical networks.HOTS: L4(Analyze).	2	2	2	2	3	3	1	1	1	--	1	1	1	3	3
CO5 **Design** basic Optical systems in an improved manner with thorough knowledge of optical transmission.HOTS: L6(Create).	1	1	3	3	3	3	3	3	3	2	3	3	1	3	3
Level of attainments:															

OPTICAL COMMUNICATION

PEC- ECE316-T

DRONE AND ANTI-DRONE TECHNOLOGY

PEC-ECE318-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of electronics, Fundamentals of Mechanical engineering

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Define** the terminologies and fundamental principles related to UAV, Drone and Anti-Drone.	LOTS: L1 (Remember)
CO2	**Understand and explain** the operation of components & various design units of drone and Anti-Drone systems.	LOTS: L2 (Understand)
CO3	**Apply** the knowledge of technical and operational requirements for drone and anti-drones.	LOTS: L3 (Apply)
CO4	**Analyze** the performance parameters of Drone andAntidrone subsystems.	HOTS: L4 (Analyze)
CO5	**Evaluate** the parameters of Drone and Antidrone subsystems for a given application.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

INTRODUCTION TO UAV AND PAYLOAD: Unmanned Aerial Vehicle, Historical aspects of UAV, classification of UAVs, applications, Deployment Restriction on UAVs, Small UAVs, system composition, Introduction to design and selection of the system: conceptual design, preliminary design, detail design, selection of the system. Payload: dispensable and non-dispensable payload, payload types: cargo freight, Reconnaissance/Surveillance, military, scientific.

UNIT -II

UAV DESIGN AND NAVIGATION: Lift induced drag, parasitic drag, rotary-wing aerodynamics, response to air turbulence, airframe configuration: HTOL, VTOL, hybrids (convertible rotor aircraft, tilt-wing). Design for stealth: acoustic, visual, radio, and radar signatures. Inertial navigation system, GPS, elements of guidance system, guidance laws, Line-of-Sight guidance law, waypoint guidance, ground control subsystem. Primary subsystem of an autopilot.

UNIT -III

DRONE DESIGN, SAFETY AND REGULATIONS: Introduction to drone and their applications. India and drones, tinkering and drones. classification of drone-based on their structure, Dynamics of an aerial system. Stability and Control. drone sensors: Accelerometer, Barometer, Gyro Sensor, Magnetometer. thermal. chemical, distance sensors. Propulsion and vertical motion, batteries of drone. building your own drone. Key features of Drone Regulations 1.0. Future of drones.

UNIT -IV

INTRODUCTION TO ANTI -DRONE TECHNOLOGY: Introduction, The need for anti-drone systems. system requirement. drone detection, identification. localization and tracking, drone neutralization. Jamming and countering techniques. anti-drone system guidelines: detector deployment, threat level assessment, Risk management. advances in drone technology: antidrone nullification technology. anti-drone system advances. Challenges in countering

TEXT AND REFERENCE BOOKS:

1. Unmanned Aircraft Design: A Review of Fundamentals, Synthesis Lectures on Mechanical engineering. Mohammad Sadraey. Morgan & Claypool Publishers series.2017.
2. Unmanned Aircraft Systems: UAVs Design. Development and Deployment, Reg Austin, Wiley, 2010.
3. Theory. Design and Applications of Unmanned Aerial vehicles, A. R. Jha. CRC press. 2016.
4. Survey on Anti-Drone Systems: Components. Designs, and Challenges. Seongjoon Park, Hyeong Tae Kim. Sangmin Lee. Hyeontae Joo . and Hwangnam Kim.
5. Counter-Drone Systems. Arthur Holland Michel, The Center for the Study of the Drone at Bard College.
6. ATL Drone Module. https://aim.gov.in/pdf/ATL_Drone_Module.pdf.

CO-PO Articulation Matrix of Drone and Anti-Drone Technology (PEC-ECE318-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. **Define** the terminologies and fundamental principles related to UAV, Drone and Anti-Drone. **LOTS: L1 (Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2. **Understand and explain** the operation of components & various design units of drone and Anti-Drone systems. **LOTS: L2 (Understand)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3. **Apply** the knowledge of technical and operational requirements for drone and anti-drones. **LOTS: L3 (Apply)**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4. **Analyze** the performance parameters of Drone andAntidrone subsystems. **HOTS: L4 (Analyze)**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5. **Evaluate** the parameters of Drone and Antidrone subsystems for a given application. **HOTS: L5 (Evaluate)**	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of Attainment:															

DRONE AND ANTI-DRONE TECHNOLOGY

PEC-ECE318-T

VLSI FABRICATION TECHNOLOGY

PEC-ECE320-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog & Digital Electronics.

Sr. No.	Course Outcomes: At the end of the semester, students will be able to:	RBT Level
CO 1	**Describe** methodology to fabricate an IC.	LOTS: L1 (Remember)
CO 2	**Understand** the diffusion of materials using different techniques.	LOTS: L2 (Understand)
CO 3	**Apply** knowledge on design tools to draw layouts for the transistor structures.	LOTS: L3 (Apply)
CO 4	**Analyze** the characterization of different materials.	HOTS: L4 (Analyze)
CO 5	**Design** and **Analyze** the advancements in CMOS process fabrication with scaling in technology.	HOTS: L6 (Create)

Course contents

UNIT I

CRYSTAL GROWTH AND WAFER PREPARATION: Era of Integrated circuits, Crystal growing techniques, Czochralski crystal growing, Float zone technique, Defects in crystal structure, Silicon wafer preparation.

OXIDATION: Thermal Oxidation of Silicon, Oxide Formation, Kinetics of Oxide Growth, Oxidation Systems, Properties of Thermal Oxides of Silicon, Impurity Redistribution during Oxidation, Uses of Silicon Oxide.

UNIT II

DIFFUSION: Basic diffusion process, Diffusion Equation, Diffusion Profiles.

ION IMPLANTATION: Requirement of ion implantation, ion implantation system, applications and other issues in ion implantation.

VLSI FABRICATION TECHNOLOGY

PEC-ECE320-T

UNIT III

EPITAXY: Vapor phase epitaxy. Liquid phase epitaxy and Molecular beam epitaxy, Chemical Vapor Deposition. types of epitaxial reactors, CVD Applications, PECVD.

PHOTOLITHOGRAPHY: Negative and Positive Photoresist, Resist Application. Exposure and Development. Photolithographic Process Control. E-Beam Lithography, X-Ray Beam Lithography and Ion Beam Lithography.

UNIT IV

ETCHING: Wet Chemical Etching, Reactive Plasma Etching.

METALLIZATION: choice of metals, methods of metallization, applications and problems in metallization.

ANNEALING: Featuras and Process of annealing.

YIELD AND RELIABILITY: Factors affecting the yield loss in VLSI. IC yield expression. Reliability requirements for VLSI.

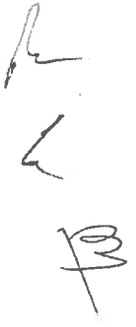
TEXT AND REFERENCE BOOKS:

1. VLSI Fabrication Principles: Silicon and Gallium Arsenide by Sorab K. Ghandhi (John Wiley & Sons).
2. VLSI Technology By S.M.Sze (2nd Edition)
3. Microelectronic Processing: An Introduction to the Manufacture of Integrated Circuits by W. Scot Ruska (McGraw Hill International Edition).
4. Microchip Fabrication: A Practical Guide to Semiconductor Processing by Peter Van Zant (2nd Edition) (McGraw Hill Publishing Company).
5. Semiconductor Devices: Physics and Technology by S.M. Sze.
6. Thin Film Processes Part I & II by John L. Vossen and Wirner Kern (Academic Press).

VLSI FABRICATION TECHNOLOGY

PEC-ECE320-T

CO-PO Articulation Matrix of VLSI Fabrication Technology (PEC-ECE320-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Describe methodology to fabricate an IC LOTS: L1 (Remember)	3	3	3	3	3	3	3	2	3	2	2	3	3	3	2
CO2 Understand the diffusion of materials using different techniques. LOTS: L2 · (Understand)	2	2	2	2	2	2	2	1	3	2	1	1	3	2	1
CO3 Apply knowledge on design tools to draw layouts for the transistor structures. LOTS: L3 (Apply)	3	3	3	3	3	3	2	1	3	3	3	2	3	3	2
CO4 Analyze the characterization of different materials. HOTS: L4 (Analyze)	3	3	2	3	3	2	2	1	2	2	3	3	3	3	2
CO5 Design and Analyze the advancements in CMOS process fabrication with scaling in technology. HOTS: L6 (Create)	3	3	3	3	3	3	2	1	3	2	2	2	3	3	2
Level of Attainment:															



VLSI FABRICATION TECHNOLOGY

PEC-ECE320-T

SPECIAL TOPICS IN VLSI

PEC-ECE407-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Digital Electronics, VLSI Design, Digital System Design.

Sr. No.	Course outcomes At end of the semester Student will be able to	RBT Level
CO1	**Define & describe** the terminology and fundamental principles of VLSI design, IC Manufacturing, Technology and current trends.	LOTS: L1 (Remember)
CO2	**Understand & describes** how technology impact on low power electronics system design.	LOTS: L2 (Understand)
CO3	**Apply** the VLSI design techniques circuit levels, logic and module levels and architecture and system design level in practical manner.	LOTS: L3 (Apply)
CO4	**Analyze** the requirements of VLSI for Emerging Technologies and system design.	HOTS: L4 (Analyze)
CO5	**Evaluate and compare** the performance of VLSI circuits and systems at various design abstraction levels.	HOTS: L5 (Evaluate)
CO6	**Create** requirements for VLSI systems design for different applications.	HOTS: L6 (Create)

Course Contents

UNIT- I

Digital System and VLSI design, IC Manufacturing and Technology, CMOS technology, IC Design techniques, IP based design, Technology and Devices and relevant materials, device and technology impact on low power electronics.

UNIT- II

Low power VLSI design-introduction, Technology and Circuit design levels, low power circuit techniques, logic and module levels, logic synthesis for low power, low power arithmetic components, low power memory design, high performance, low power clock distribution

UNIT- III

Architecture and system design level, algorithms and architecture level methodologies, System-SOC, buses and network on chips, Emerging Technologies- Open-Source Processor Architecture (RISC-V), Neuromorphic Computing, Edge Computing, Flexible Electronics

UNIT- IV

VLSI design automation (EDA) tools, design methodologies, design problems and algorithms a brief introduction- layout compaction, placement and partitioning, floor planning, routing, simulation, logic synthesis and verification, High level synthesis, industrial and opensource

TEXT AND REFERENCE BOOKS:

1. Modern VLSI design-IP-based design, Wayne Wolf, Pearson, 4th Edition, 2015
2. Low Power CMOS VLSI Circuit Design, Kaushik Roy, Sharat C. Prasad, Wiley, 2014
3. Low Power Design Methodologies, Jan M. Rabaey, Massoud Pedram, Springer, 2012
4. Practical Low Power Digital VLSI Design, Gary Yeap, Springer, 2014
5. Low- Voltage, Low- Power VLSI Subsystems, K.- Seng Yeo, Kaushik Roy, Mc Graw Hill, 2014
6. Algorithms for VLSI Design Automation, Sabih H. Gerez, Wiley, 2014
7. Principles of CMOS VLSI Design- A System and Circuit Perspective, Neil Weste, K Eshraghian, 2nd Edition, 2001
8. Introduction to VLSI Design flow, Sneh Saurabh, Cambridge University Press
9. Digital Design with an Introduction to Verilog HDL, M Morris Mano, Michael D. Ciletti, 5th Edition, Pearson, 2017
10. Advanced FPGA Design, architecture, Implementation, and Optimization, Steve Kilts, John Wiley and Sons, 2007

SPECIAL TOPICS IN VLSI

PEC-ECE407-T

CO-PO Articulation Matrix of Special Topics in VLSI (PEC-ECE407-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 **Define & describe** the terminology and fundamental principles of VLSI design. IC Manufacturing. Technology and current trends. **LOTS: L1 (Remember)**	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2 **Understand & describes** how technology impact on low power electronics system design. **LOTS: L2 (Understand)**	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3 **Apply** the VLSI design techniques circuit levels, logic and module levels and architecture and system design level in practical manner. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4 **Analyze** the requirements of VLSI for Emerging Technologies and system design. **HOTS: L4 (Analyze)**	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5 **Evaluate and compare** the performance of VLSI circuits and systems at various design abstraction levels. **HOTS: L5 (Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6 **Create** requirements for VLSI systems design for different applications. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
Level of Attainment:															

ANTENNA & WAVE PROPAGATION

PEC-ECE409-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Electromagnetic Theory

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO1	**Outline** the basic fundamental concepts of antenna.	LOTS: L1 (Remember)
CO2	**Understand** the various types of antenna in transmission and reception of signals.	LOTS: L2 (Understand)
CO3	**Apply** different wave propagation theories in communications.	LOTS: L3 (Apply)
CO4	**Analyze** antennas depending upon modes of propagation and their applications.	HOTS: L4 (Analyze)
CO5	**Design** an antenna for various applications in communication.	HOTS: L6 (Create)

Course Contents

UNIT-I

RADIATION OF ELECTROMAGNETIC WAVES: Short Electric Dipoles, Retarded potential, Radiation from a Small Current Element, field of short dipole, Power Radiated by a Current Element and Its Radiation Resistance, Linear antenna, half wave dipole, Radiation from a Half Wave Dipole, Antenna impedance, Effect of ground on antenna pattern, Input impedance, Mutual Impedance.

UNIT-II

ANTENNA PARAMETERS: Antenna Pattern, Antenna Parameters, Front to Back Ratio, Gain, Directivity, Radiation Resistance, Radiation Patterns, Radiation Power Density, Radiation Intensity Efficiency, Aperture Area, Impedance, Effective Length and Beam width, Reciprocity Theorem for Antenna and Its Applications.

UNIT –III

ANTENNA ARRAYS AND TYPES OF ANTENNAS: Types of Antenna Array: Broadside Array, End Fire Array, Collinear Array and Parasitic Array, Two element array, array of point sources, pattern multiplication, Linear Array, Phased Array, Tapering of Arrays, Binomials Arrays, Isotropic Antenna ,Yagi-Uda, Microwave antenna, parabolic feeds, conical, helix, log periodic, horn, Microstrip Antenna and Patch Antenna, Frequency independent concept, RUMSEY'S Principle, Frequency independent planar log spiral antenna, Frequency independent conical spiral Antenna.

UNIT-IV

PROPAGATION: Modes of Propagation, Space wave and Surface Wave, Reflection and refraction of waves by the ionosphere, Tropospheric Wave propagation, bending mechanism of waves by ionosphere, Virtual Height, MUF, Critical frequency, Skip Distance, Duct Propagation, Space wave.

TEXT AND REFERENCE BOOKS:

1. Antennas by J.D. Kraus, Mcgraw Hill Higher Education: 3rd edition
2. Antennas and Wave Propagation – K.D. Prasad, Satya Prakashan, Tech India Publications. 3rd edition
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill. 1st edition
4. Antenna & Radiowave Propogation by Collin,TMH, 4th edition
5. Electromagnetic Waves & Radiating Systems by Jordan & Balman, PHI., 2nd edition
6. Electromagnetic Waves, R.L. Yadav, Khanna Publishing House. 1st edition

CO-PO Matrix of Antenna & Wave Propagation (PEC-ECE409-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Outline the basic fundamental concepts of antenna. **LOTS: L1 (Remember)**	3	3	2	2	1	2	2	2	2	1	1	2	3	2	2
CO2 Understand the various types of antenna in transmission and reception of signals. **LOTS: L2 (Understand)**	3	3	2	2	2	2	1	2	2	2	2	2	3	3	2
CO3 Apply different wave propagation theories in communications. **LOTS: L3 (Apply)**	3	3	2	2	1	2	2	1	2	2	2	2	3	2	2
CO4 Analyse antennas depending upon modes of propagation and their applications. **HOTS: L4 (Analyze)**	3	3	3	2	1	2	2	1	2	1	3	2	3	3	3
CO5 Design an antenna for various applications in communication. **HOTS: L6 (Create)**	3	3	3	2	2	2	1	1	2	2	2	2	3	3	3
Level of attainments:															

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING

PEC-ECE411-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability Theory, Mathematics.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Define & describe** the terminology and fundamental principles related to artificial intelligence and machine learning.	LOTS: L1 (Remember)
CO2	**Understand & explain** various AI problems, agents and algorithms used in artificial intelligence and machine learning.	LOTS: L2 (Understand)
CO3	**Apply** AI and machine learning algorithms.	LOTS: L3 (Apply)
CO4	**Analyze** the performance of AI and machine learning based algorithms.	HOTS: L4 (Analyze)
CO5	**Implement** logic and algorithms to solve real world problems using artificial intelligence & machine learning algorithms.	HOTS: L6 (Create)

Course Contents

UNIT-I

INTRODUCTION: Introduction to Artificial Intelligence, Turing Test, Applications of Artificial Intelligence, Intelligent Agents: Agents and Environments, task environment and its properties, Structure of Intelligent Agents: simple reflex agents, Model based reflex agents, Goal based agents, utility based agents, learning agents, AI Toy and real world problems.

UNIT-II

PROBLEM-SOLVING: Problem solving agents, problem formulation, searching for solutions, Uninformed search strategies: Breadth first search, Depth first search, iterative deepening depth first search, Informed Search Strategies: Best first search, A* search, Local search algorithms: Hill climbing search, optimization algorithm: Genetic algorithm problems, Search for games: The minimax algorithm, Alpha-beta pruning.

UNIT –III

KNOWLEDGE & REASONING: Knowledge based agents. Propositional logic: Syntax & semantics First order Logic: Syntax and semantics, Inference in First order logic. Fuzzy Logic: Basic concepts of Fuzzy logic. Fuzzy vs Crisp set, Linguistic variables, membership functions, operations of Fuzzy sets, Fuzzy if then rules, Fuzzy relations, Operations on fuzzy relations, defuzzification techniques.

UNIT-IV

MACHINE LEARNING: Supervised, unsupervised and reinforcement learning. Inductive learning: Decision Tree. Statistical learning: Bayesian learning. Bayes Theorem, Naïve Bayes Model. K-nearest neighbor learning, k-means clustering, Neural Networks. Support Vector Machines. Model Combination Schemes: Voting, Bagging, Boosting: Adaboost.

TEXT AND REFERENCE BOOKS:

1. Artificial Intelligence- A Modern Approach. Stuart Russell. Peter Norvig. Pearson Education.
2. Hands on Machine Learning with Scikit-Learn & TensorFlow. Aurelien Geron. O'Reilly Media Inc.
3. Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications. S. Rajasekaran & G.A.Vijayalakshmi Pai, PHI.
4. Artificial intelligence, Elaine Rich. Kevin Knight and Shivashankar B Nair. McGraw Hill Education.
5. Introduction to Machine Learning. Ethem Apaydin. MIT Press.
6. Machine Learning, Tom M. Mitchell. McGraw-Hill.

CO-PO Articulation Matrix of Artificial Intelligence & Machine Learning Lab (PEC-ECE411-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Define & describe the terminology and fundamental principles related to artificial intelligence and machine learning. **LOTS: L1 (Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 Understand & explain various AI problems, agents and algorithms used in artificial intelligence and machine learning. **LOTS: L2 (Understand)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 Apply AI and machine learning algorithms. **LOTS: L3 (Apply)**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4 Analyse the performance of AI and machine learning based algorithms. **HOTS: L4 (Analyse)**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 Implement logic and algorithms to solve real world problems using artificial intelligence & machine learning algorithms. **HOTS: L6 (Create)**	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of attainments:															

OBJECT ORIENTED PROGRAMMING USING JAVA

PEC- ECE413-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Object-Oriented Concepts and programming in any Object Oriented language.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**List** object oriented characteristics peculiar to JAVA programming.	LOTS: L1 (Remember)
CO2	**Describe** object-oriented principles and paradigms implemented by Java programming language.	LOTS: L2 (Understand)
CO3	**Apply** object-oriented principles for solving problems using JAVA.	LOTS: L3 (Apply)
CO4	**Identify** classes, interfaces methods, hierarchy in the classes for a given programming problem in JAVA.	HOTS: L4 (Analyze)
CO5	**Design** Graphical User Interface applications and Web based applications in Java by importing applet, AWT and SWING packages.	HOTS: L6 (Create)

Course Contents

UNIT-I

OBJECT-ORIENTED PROGRAMMING CONCEPTS: Object, Classes, Procedural and object oriented programming concepts, Major Features: Encapsulation, Abstraction, Inheritance, and Polymorphism. Java Programming Fundamentals: History of Java, Garbage collections and Memory Management, Constants, variables, data types, operators and expressions, type casting. Control statements: if-else, for, while, & do-while loops and switch statements. Methods, constructors, access modifiers, overloading methods and overloading constructors.

UNIT -II

IMPLEMENTING OOP: Inheritance and its types, super and sub classes, super keyword, overriding methods, and interfaces, multiple inheritance using interfaces. Method Overriding, Abstract Methods and Classes,

Exception Handling: Exceptions in java, exception class, try, catch and finally statements, Multiple catch statements, Creating and handling user-defined exceptions, Working with Packages: Packages-Defining, Creating and importing a Package.

UNIT –III

WORKING WITH GUI: AWT and Swing components, Layout Manager, Event Handling: event listeners, event handlers, Event classes: ActionEvent, MouseEvent, Event listeners interfaces: ActionListener, TextListener, WindowListener, Creating Button, Textfield, ComboBox, Menus and Its Items, Threads: Multithreading, Thread class and Runnable interface, life cycle of a thread, Thread priority, Thread synchronization.

UNIT –IV

FILE HANDLING: Understanding a stream, Input and output streams, character streams, byte stream, understanding File classes, Reading a File, Writing a File, Database Connectivity: Introduction to SQL statements, JDBC API: Connection, Statements, Prepared Statements, Record Set and execute statements.

TEXT AND REFERENCE BOOKS:

1. Paul Deital, Harvey Deital, JavaTM: How to Program, 9th Edition, Pearson Education (Prentice Hall), 2012.
2. Herbert Schildt, JavaTM: The Complete Reference, 7th Edition, McGraw-Hill, 2007.
3. Kathy Sierra, Bert Bates, Head First Java, 2nd Edition, O'Reilly, 2005.
4. Ralph Bravaco , Shai Simoson, Java Programming From the Ground Up, Tata McGraw-Hill, 2009.
5. Sachin Malhotra, Saurabh Chaudhary, Programming in Java, Oxford University Press, 2011.
6. E. Balagurusamy, Programming with Java: A Premier, 3rd Edition, Tata McGraw-Hill, New Delhi, 2007.
7. DT Editorial Services, Java 8 Programming, Black Book, Dreamtech Press, New Delhi, 2015.

CO-PO Articulation Matrix of Object Oriented Programming using Java (PEC- ECE413-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 List object oriented characteristics peculiar to JAVA programming. LOTS: L1 (Remember).	3	1	1	2	--	--	--	--	--	--	1	1	3	2	2
CO2 Describe object-oriented principles and paradigms implemented by Java programming language. LOTS: L2(Understand).	3	2	3	3	2	--	--	--	--	--	2	3	3	2	2
CO3 Apply object-oriented principles for solving problems using JAVA. LOTS: L3(Apply).	2	3	2	2	3	3	1	1	2	--	2	2	2	3	3
CO4 Identify classes, interfaces methods, hierarchy in the classes for a given programming problem in JAVA. .HOTS: L4(Analyze).	2	2	2	2	3	3	1	1	1	--	1	1	1	3	3
CO5 Design Graphical User Interface applications and Web based applications in Java by importing applet, AWT and SWING packages. HOTS: L6(Create).	1	1	3	3	3	3	3	3	3	2	3	3	1	3	3
Level of attainments:															

OBJECT ORIENTED PROGRAMMING USING JAVA

PEC- ECE413-T

COMPUTER GRAPHICS

PEC-ECE-415-T

General Course Information:

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods (internal: 30; external: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks. .

Pre-requisites: Linear algebra, calculus, geometry, and trigonometry.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Understand** the fundamental concepts of computer graphics and its applications, including graphics input and output devices, graphics software, and the different types of display systems.	LOTS:L1 & L2(Understand)
CO2	**Apply** different line drawing algorithms and circle drawing algorithm for various 2D graphics.	LOTS:L3(Apply)
CO3	**Analyze** and implement different 2D and 3D transformations, composite transformation and projection techniques for various graphics applications.	HOTS:L4(Analyze)
CO4	**Evaluate** the various hidden surface removal techniques and polygon clipping techniques for their effectiveness in handling different graphics scenarios.	HOTS:L5(Evaluate)
CO5	**Create** and represent curves and surfaces using parametric representation of curves and surfaces using interpolation methods.	HOTS:L6(Create)

Course Contents

UNIT- I

INTRODUCTORY CONCEPTS:
Computer Graphics and its Applications. **Graphics Input Devices:** Keyboard, Mouse, Track-ball, space ball, Joysticks, data Glove, Light Pen, Digitizer, Image scanners, touch panels, voice systems: Graphics software

GRAPHICS OUTPUT DEVICES:
CRT, Raster Scan & Random Scan systems; Color CRT monitors, DVST, flat-panel displays, video controller and raster scan display processor.

GRAPHICS OUTPUT PRIMITIVES:
Point and Lines, Line Drawing Algorithms: Simple, DDA, Bresenham's Line Drawing algorithm, Mid-point Circle drawing algorithm.

UNIT- II

2D VIEWING: Viewing pipeline, Window-to-viewport transformation, 2-D Clipping, Chen-Sutherland Line Clipping, Mid-point subdivision algorithm, Liang-Barsky clipping, Cyrus-Beck line clipping; Polygon Clipping: Sutherland-Hodgeman and Weiler-Atherton polygon clipping

TWO DIMENSIONAL TRANSFORMATIONS: transformations, translation, scaling, rotation, reflection, composite transformation.

THREE DIMENSIONAL TRANSFORMATIONS: Three dimensional graphics concept, Matrix representation of 3-D Transformations, Composition of 3-D transformation.

UNIT -III

PROJECTIONS: Projections, types of projections, the mathematics of planner geometric projections, coordinate systems.

HIDDEN SURFACE REMOVAL: Introduction to hidden surface removal, Z- buffer algorithm, scanline algorithm, area sub-division algorithm.

UNIT -IV

REPRESENTING CURVES AND SURFACES: Parametric representation of curves: Bezier curves, B-Spline curves. Parametric representation of surfaces; Interpolation method.

ILLUMINATION, SHADING, IMAGE MANIPULATION: Illumination models, shading models for polygons.

TEXT AND REFERENCE BOOKS:

1. Computer Graphics Principles and Practices second edition by James D. Foley, Andeies van Dam, Stevan K. Feiner and Johb F. Hughes, 2000, Addision Wesley.
2. Computer Graphics by Donald Hearn and M.Pauline Baker, 2nd Edition, 1999, PHI
3. Procedural Elements for Computer Graphics – David F. Rogers, 2001, T.M.H Second Edition
4. Fundamentals of 3Dimensional Computer Graphics by Alan Watt, 1999, Addision Wesley.
5. Computer Graphics By Pradeep K Bhatia, IK International Pub, New Delhi, 3ed, 2013

CO-PO Articulation Matrix of Computer Graphics Course (PEC-ECE-415-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Understand the fundamental concepts of computer graphics and it's applications, including graphics input and output devices, graphics software, and the different types of display system.	1	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2 Apply different line drawing algorithms and Circle drawing algorithm, for drawing various 2D graphics.	2	1	–	–	2	–	–	–	–	–	–	–	3	–	–
CO3 Analyze and implement different 2D and 3D transformations , composite transformation and projection techniques for various graphics applications.	-	2	2	2	1	–	–	–	–	–	–	–	3	–	–
CO4 Evaluate the various hidden surface removal techniques and polygon clipping for their effectiveness in handling different graphics scenarios.	2	1	–	–	2	–	–	–	–	–	–	–	3	–	–
CO5 Create and represent curves and surfaces using parametric representation of curves and surfaces using interpolation methods.	1	2	2	–	3	–	–	–	–	–	-	–	3	–	–
Level of Attainments:															

COMPUTER GRAPHICS

PEC-ECE-415-T

ADVANCE COMPUTER ARCHITECTURE

PEC-ECE417-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog and Digital Electronics

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able to:**	**RBT Level**
CO1	**Define and describe** the terminologies and fundamental principles related to computer architecture and organisation.	LOTS: L1 (Remember)
CO2	**Understand and explain** the operation of the processor, control unit, memory organisation and I/O interfacing.	LOTS: L2 (Understand)
CO3	**Apply** the knowledge of computer architecture in the design of basic building blocks for the computer.	LOTS: L3 (Apply)
CO4	**Analyze** the design of the basic building blocks/modules of the computer system.	HOTS: L4 (Analyze)
CO5	**Evaluate** the design of the basic building blocks and modules of the computer system.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

INTRODUCTION: Organisation and architecture, structure and functions; Performance issues: designing for performance, multicore, MICS, GPGPUs, Ahmdahl's law, basic measure of computer performance. Computer architecture: Application Processors versus Dedicated Processors, microprocessor Vs microcontroller, Processor organisation, register organisation, user-visible register, control and status register, instruction cycle.

UNIT -II

INSTRUCTION PIPELINING: pipelining strategy, pipeline performance, pipeline hazards (resource, data and control), elements of machine instruction, instruction representation, multiple processor organisation: types of parallel processor systems, parallel organisation, CUDA basics, GPU Vs CPU. Control Unit: Microoperations, control of the processor(functional requirement), hardwired and microprogrammed implementation of control unit

UNIT -III

INTEL PROCESSOR : Introduction, architecture of 8086, EU, BIU, accessing memory locations, Pin details of 8086. Addressing Modes: register addressing, immediate addressing, data memory, program memory, stack memory; segment override prefix. Instruction set: data transfer, arithmetic, logical, flag manipulation, control transfer, shift/rotate, string, machine or processor control, assembly language programming, assembler directives.

UNIT -IV

MEMORY HIERARCHY & I/O TECHNIQUES: computer memory system overview, characteristic of memory systems, the memory hierarchy, cache memory principles, elements of cache design: cache addresses, cache size, mapping function: (direct mapping, associative mapping), replacement algorithms: Main memory: organisation, DRAM, SRAM, chip logic, interleaved memory, DDR DRAM, flash memory, newer non volatile solid state memory technologies, solid state drives, interrupt driven I/O, Direct memory access.

TEXT AND REFERENCE BOOKS:

1. William stalling, Computer Organization and Architecture Designing for Performance, (10th ed) Pearson Education, 2016.
2. N. Senthil Kumar, M. Saravanan et al., Microprocessor and Interfacing: 8686, 8051, 8096 and advanced microprocessor, Oxford.
3. Douglas V hall & SSSP RAO, Microprocessor and interfacing (3ed), Mc Graw Hill
4. John L. Hennessy, David A. Patterson, Computer architecture, A quantitative approach.(6ed), Morgan Kaufmann.
5. M. Morris Mano, Computer system architecture (Revised 3ed), Pearson Education.2017.

CO-PO Articulation Matrix of Advance Computer Architecture (PEC-ECE417-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 **Define and describe** the terminologies and fundamental principles related to computer architecture and organisation.	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 **Understand and explain** the operation of the processor, control unit, memory organisation and I/O interfacing.	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 **Apply** the knowledge of computer architecture in the design of basic building blocks for the computer.	2	2	2	2	1	–	–	–	1	–	–	2	2	2	2
CO4 **Analyze** the design of the basic building blocks/modules of the computer system.	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 **Evaluate** the design of the basic building blocks and modules of the computer system.	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of attainments:															

ADVANCE COMPUTER ARCHITECTURE

PEC-ECE417-T

SPECIAL TOPICS IN VLSI LAB

PEC-ECE407-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Digital Electronics, VLSI Design, Digital System Design.

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	**Apply** theoretical knowledge of Digital System design for VLSI chip design and planning.	LOTS: L3 (Apply)
CO2	**Analyze and evaluate** the performance of VLSI circuits at technology and circuit levels, logic and module levels and Architecture and system design level in practical manner.	HOTS: L4 & L5 (Analyze & Evaluate)
CO3	**Integrate** knowledge of Low power VLSI design to model the VLSI systems at technology and circuit levels, logic and module levels and Architecture and system design level.	HOTS: L6 (Create)
CO4	**Create and design** the VLSI circuit and systems for different applications.	HOTS: L6 (Create)
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Familiarization with EDA tools for VLSI system design and unix shell programming
2. Code Converters
3. Decoder. Encoders, priority encoder
4. Multiplexer/ Demultiplexers
5. Adders/Subtractors
6. Flip Flops. Shift Registers. Universal Shift Registers
7. Counters
8. Memories
9. Multipliers/
10. Filters
11. BIST
12. ALU
13. Processor-FPU basics

NOTE: At least 10 experiments are to be performed in the semester. out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 14) in the group of two-three students before the semester ends.

SPECIAL TOPICS IN VLSI LAB

PEC-ECE407-P

CO-PO Articulation Matrix of Special Topics in VLSI Lab (PEC-ECE407-P)															
List of Course Outcomes		PO1	PO 2	PO 3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2	PSO3
CO1	Apply theoretical knowledge of Digital System design for VLSI chip design and planning. **LOTS: L3 (Apply)**	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2	**Analyze and evaluate** the performance of VLSI circuits at technology and circuit levels, logic and module levels and Architecture and system design level in practical manner. **HOTS: L4 & L5 (Analyze & Evaluate)**	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3	**Integrate** knowledge of Low power VLSI design to model the VLSI systems at technology and circuit levels, logic and module levels and Architecture and system design level. **HOTS: L6 (Create)**	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4	**Create and design** the VLSI circuit and systems for different applications. **HOTS: L6 (Create)**	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of Attainments:																

SPECIAL TOPICS IN VLSI LAB

PEC-ECE407-P

ANTENNA AND WAVE PROPAGATION LAB

PEC-ECE409-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.)

Pre-requisites: Electromagnetic Theory

Sr. No.	Course outcomes At end of the semester: **Student will be able to**	RBT Level
CO1	**Examine** basic antenna parameters like radiation pattern, directivity and gain.	LOTS: L1 (Remember)
CO2	**Demonstrate** performance parameters of uniform linear antenna arrays.	LOTS: L3 (Apply)
CO3	**Analyze** special type of antennas like microstrip antennas.	HOTS: L4(Analyze)
CO4	**Evaluate** the structure and operation of various antennas and describe their performance.	HOTS: L5 (Evaluate)
CO5	**Create** the basic models of dipole antennas.	HOTS: L6 (Create)

ANTENNA AND WAVE PROPAGATION LAB

PEC-ECE409-P

LIST OF EXPERIMENTS

1. To study different Antenna parameters and their importance.
2. To analyze the performance parameters of dipole antenna.
3. To analyze the performance parameters folded dipole antenna
4. To analyze the performance parameters of monopole antenna.
5. To analyze the performance parameters of Yagi-Uda antenna.
6. To study the different performance parameters of N element antenna array.
7. To analyze the different performance parameters of Horn antenna.
8. To analyze the performance parameters of reflector antenna.
9. To design a coaxial feed rectangular microstrip antenna using FR4 substrate with dielectric constant 4.4, h=1.6 mm resonating at 2.4 GHz.
10. To design inset feed microstrip antenna using FR4 substrate with dielectric constant 4.4, h=1.6 mm resonating at 2.4 GHz.

SOFTWARE REQUIRED: HFSS/Scilab/CST/MATLAB

NOTE: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of Antenna And Wave Propagation Lab (PEC-ECE409-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Examine basic antenna parameters like radiation pattern, directivity and gain. LOTS: L1 (Remember)	3	3	2	2	3	3	2	1	2	3	2	2	3	2	2
CO2 Demonstrate performance parameters of uniform linear antenna arrays. LOTS: L3 (Apply)	3	3	2	2	2	3	1	-	3	2	2	2	3	2	3
CO3 Analyse special type of antennas like micro strip antennas. HOTS: L4(Analyze)	3	3	2	2	3	3	1	-	2	2	2	2	3	3	2
CO4 Evaluate the structure and operation of various antennas and describe their performance. HOTS: L5 (Evaluate)	3	3	3	2	3	2	2	2	3	2	3	2	3	3	3
CO5 Create the basic models of dipole antennas. HOTS: L6 (Create)	3	3	3	2	2	2	1	2	3	3	3	2	3	3	2
Level of Attainments:															

ANTENNA AND WAVE PROPAGATION LAB

PEC-ECE409-P

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

PEC-ECE411-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50); External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Programming Skills

S.No.	**Course Outcomes:** **By the end of the lab course a student would be able to:**	**RBT Level**
CO1	**Apply** modern programming tools to implement AI & ML algorithms.	LOTS:L3 (Apply)
CO2	**Evaluate** the performance of AI & ML algorithms.	HOTS:L5 (Evaluate)
CO3	**Devise** software solutions for common AI and ML problems.	HOTS:L6 (Create)
CO4	**Create** written records for the given assignments with problem definition, design of solution and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

ARTIFICIAL INTELLIGENCE & MACHINE LEARNING LAB

PEC-ECE411-P

LIST OF EXPERIMENTS/ASSIGNMENTS

1. Explore functions of Python Basic Libraries such as Math, Numpy and Scipy.
2. Explore functions of Python Libraries for ML applications such as Pandas and Matplotlib.
3. Explore MATLAB functions used for ML applications.
4. Explore built in function used to evaluate performance of any ML algorithm.
5. Write a program for Creation and loading of different datasets.
6. Write a program to implement reshaping, filtering, merging and handling the missing values in given datasets.
7. Write a program to compute statistical features such as mean, median, mode, variance and standard deviation from given datasets.
8. Write a program to implement feature reduction algorithm.
9. Write a program to implement simple linear regression to solve regression problem.
10. Write a program to implement Logistic regression to solve classification problem.
11. Write a program to implement Support Vector Machine to solve classification problem.
12. Write a program to implement K- nearest neighbor classifier.
13. Write a program to implement Adaboost algorithm to solve classification problem.
14. Write a Program to Implement Breadth First Search algorithm.
15. Write a Program to Implement Depth First Search algorithm.
16. Write a Program to Implement Tic-Tac-Toe game.
17. Write a Program to Implement 8-Puzzle problem.
18. Write a Program to Implement Water-Jug problem.
19. Write a Program to Implement Travelling Salesman Problem.

SOFTWARE REQUIRED: PYTHON/MATLAB

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of Artificial Intelligence & Machine Learning Lab(PEC-ECE411-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply modern programming tools to implement AI & ML algorithms. **LOTS: L3 (Apply)**	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2 **Evaluate** the performance of AI & ML algorithms. **HOTS:L5 (Evaluate)**	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3 **Devise** software solutions for common AI and ML problems. **HOTS: L6 (Create)**	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4 **Create** written records for the given experiments with problem definition, solution, observations and conclusions. **HOTS: L6 (Create)**	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5 **Demonstrate** ethical practices while performing lab experiments individually or in groups. **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of attainments:															

OBJECT ORIENTED PROGRAMMING USING JAVA LAB

PEC-ECE-413-P

General Course Information:

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Object-Oriented Concepts and programming.

Sr. No.	**Course Outcomes:** **By the end of the lab course a student would be able to:**	
CO1	**Implement** Java programs using object-oriented concepts for problem solving.	(LOTS: Level 3: Apply)
CO2	**Detect** syntax and logical errors in java programs	(HOTS: Level 4: Analyse)
CO3	**Apply** exception handling for making robust JAVA code.	(HOTS: Level 3: Apply)
CO4	**Design** java applications using File I/O and GUI.	(HOTS: Level 6: Create)
CO5	**Create** lab record of the solutions of assignments that includes problem definitions, solutions and conclusions.	(HOTS: Level 6: Create)
CO6	**Demonstrate** ethical practices, self-learning and team spirit.	(LOTS: Level 3: Apply)

OBJECT ORIENTED PROGRAMMING USING JAVA LAB

PEC-ECE-413-P

List of Experiments/assignments:

1. Use eclipse or NetBeans platform and acquaint with the various menus. create a test project, add a test class and run it to see how you can use auto suggestions and auto fill functionalities. Try code formatter and code refactoring like renaming variables, methods and classes. Try debug step by step with a small program of about 10 to 15 lines which contains at least one if else condition and a for loop.
2. Write a program to illustrate the class, objects, methods, arrays and various data types in java.
3. Write a program to illustrate the use of control, looping statements and user defined functions.
4. Write a program to illustrate the implementation of various forms of inheritance.
5. Write a program to illustrate the method overloading.
6. Write a program to illustrate the polymorphism and method overriding.
7. Write a program to illustrate the implementation of exception handling.
8. Write a program to illustrate the interfaces in java.
9. Write a program to illustrate the create package in java.
10. Write a program to illustrate design of multithreaded programs in java.
11. Write a program to illustrate event handling.
12. Write a program to illustrate the java applets.
13. Write a program to illustrate the design of a GUI application.
14. To access and update data from a database using JDBC.

Note: The actual experiments/assignments will be designed by the course coordinator. One assignment should be designed to be done in groups of two or three students. The assignments must meet the objective of the course and the levels of the given course outcomes. The list of assignments and schedule of submission will be prepared by the course coordinator at the beginning of the semester.

CO-PO Articulation Matrix of OBJECT ORIENTED PROGRAMMING USING JAVA LAB (PEC-ECE-413-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Implement Java programs using object oriented concepts for problem solving (LOTS: L3: Apply).	1	1	1	1	_	_	_	_	1	_	_	1	2	2	2
CO2 Detect syntax and logical errors in java programs (HOTS: L4: Analyse).	1	1	1	1	_	_	_	_	1	_	_	1	2	2	2
CO3 Apply exception handling for making robust JAVA code. (HOTS: L 3: Apply).	2	2	2	2	1	_	-	_	1	_	_	2	2	2	2
CO4 Design java applications using File I/O and GUI. (HOTS: L6: Create)	3	3	3	3	1	_	2	_	1	_	_	3	3	3	3
CO5 Create lab record of the solutions of assignments that includes problem definitions, solutions and conclusions (HOTS: L6: Create).	3	3	3	3	2	_	2	_	2	_	_	3	3	3	3
CO5 Demonstrate ethical practices, self-learning and team spirit (LOTS: L3: Apply).	3	3	3	3	2	_	2	_	2	_	_	3	3	3	3

COMPUTER GRAPHICS LAB

PEC-ECE-415-P

General Course Information:

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites:

A fundamental understanding of programming concepts, familiarity with the C programming language, and basic mathematics knowledge, including coordinate systems and algebra. Additionally, a basic understanding of 2D and 3D geometry can be helpful in understanding the different algorithms used in computer graphics.

COMPUTER GRAPHICS LAB

PEC-ECE-415-P

Sr. No.	Course outcomes At end of the semester, Student will be able to	RBT Level
CO1	**Recall** the basic concepts of computer graphics and C graphics library functions by identifying and listing the different shapes that can be drawn using the graphics library.	L1(Recall)
CO2	**Apply** the DDA and Bresenham line drawing algorithms to draw lines on a graphical canvas and compare the performance and efficiency of both algorithms.	L2(Apply)
CO3	**Analyze** the Bresenham circle drawing algorithm and Mid-Point ellipse drawing algorithm by implementing them and comparing their results.	L4(Analyze)
CO4	**Evaluate** and select an appropriate polygon filling algorithm from Scanline, Flood Fill, and Boundary Fill algorithms by analyzing their efficiency and complexity, and implement it on a sample polygon.	L5(Evaluate)
CO5	**Create** and design a simple graphical application or game by applying 2D transformation techniques such as translation, scaling, rotation, and reflection to a sample object, and implement line and polygon clipping algorithms to optimize the graphics performance. Additionally, document the implementation process and present the project in a clear and engaging manner.	L6(Create)

List of Programs

1. **Introduction to Computer Graphics and C Graphics Library:**
    a. Basic concepts of computer graphics and its applications
    b. Introduction to C graphics library
    c. Drawing simple geometric shapes using graphics library functions
2. **Line Drawing Algorithms:**
    a. DDA line drawing algorithm
    b. Bresenham line drawing algorithm
3. **Circle Drawing Algorithms:**
    a. Bresenham circle drawing algorithm
    b. Mid-Point circle drawing algorithm
4. **Polygon Filling Algorithms:**
    a. Scanline polygon filling algorithm
    b. Flood fill polygon filling algorithm
    c. Boundary fill polygon filling algorithm
5. **2D Transformations:**
    a. Translation transformation
    b. Scaling transformation
    c. Rotation transformation
    d. Reflection transformation
    e. Composite transformation
6. **Line Clipping Algorithms:**
    a. DDA line drawing algorithm
    b. Bresenham line drawing algorithm
7. **Polygon Clipping Algorithm:**
    a. Scanline polygon filling algorithm
    b. Flood fill polygon filling algorithm
    c. Boundary fill polygon filling algorithm
8. **Minor Project:**

    Students will be given a problem statement related to computer graphics and asked to implement a solution using the concepts and algorithms learned during the lab sessions. The project could involve tasky such as creating a simple game or developing an interactive graphical application.

CO-PO Articulation Matrix of COMPUTER GRAPHICS LAB (PEC-ECE-415-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Recall the basic concepts of computer graphics and C graphics library functions by identifying and listing the different shapes that can be drawn using the graphics library.	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2 Apply the DDA and Bresenham line drawing algorithms to draw lines on a graphical canvas and compare the performance and efficiency of both algorithms.	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3 Analyze the Bresenham circle drawing algorithm and Mid-Point ellipse drawing algorithm by implementing them and comparing their results.	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4 Evaluate and select an appropriate polygon filling algorithm from Scanline, Flood Fill, and Boundary Fill algorithms by analyzing their efficiency and complexity, and implement it on a sample polygon.	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5 Create and design a simple graphical application or game by applying 2D transformation techniques such as translation, scaling, rotation, and reflection to a sample object, and implement line and polygon clipping algorithms to optimize the graphics performance. Additionally, document the implementation process and present the project in a clear and engaging manner.	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of attainments:															

SYSTEM VERILOG LAB

PEC-ECE402-P

ADVANCE COMPUTER ARCHITECTURE LAB

PEC-ECE417-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments. the quality of solutions designed for the assignments. the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and. compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic concepts of Digital Electronics and Logic Design. Computer Organization.

Sr. No.	Course Outcomes: Attheendofthesemester,studentswillbeable to:	RBT Level
CO1	**Apply** theoretical concepts related to computer architecture in programming the devices.	LOTS: L3 (Apply)
CO2	**Analyze** the working and performance of the instruction set. addressing modes and devices used in the experiment.	HOTS: L4 (Analyze)
CO3	**Integrate** the knowledgeof computer architecturefor communication between microprocessorsand external devices.and write program to control these devices.	HOTS: L6 (Create)
CO4	**Create** written records for the given experiments with problem definitions. solutions. observations and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while performing lab experiments individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Write an assembly language program to perform addition and subtractionof two multibyte numbers.
2. Write an assembly language program to perform multiplication for two 8/16 bit numbers.
3. Write an assembly language program to perform division.
4. Write a program to move a block of data with and without overlap.
5. Writean assembly language program to perform the conversion from BCD to binary.
6. Write an assembly language program to sort numbers in ascending &descending order.
7. Write an assembly language program to count the number of ones and zeros in a given data.
8. Write an assembly language program to find the largest& smallest from given numbers.
9. Write an assembly language program to separate odd and even numbers.
10. Write an assembly language program to separate positive and negative numbers
11. Write an assembly language program to print a string.
12. Scan 4*4 keyboard for key closure and display the corresponding key code.
13. Implement Seven segments LED display interface with the microprocessor.
14. Implement DC Motor interfacing with Microprocessor.
15. Implement Stepper motor interfacing with Microcontroller.
16. Implement Temperature sensor interfacing with Microprocessor.
17. Implement Accelerometer sensor interfacing with Microprocessor.
18. Simple project (Any topic related to the scope of the course)

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope ofthe syllabus.

CO-PO Articulation Matrix of ADVANCE COMPUTER ARCHITECTURE LAB (PEC-ECE417-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply theoretical concepts related to computer architecture in programming the devices.	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2 Analyze the working and performance of the instruction set, addressing modes and devices used in the experiment.	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3 Integratethe knowledgeof computer architecturefor communication between microprocessors and external devices, and write program to control these devices.	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4 Create written records for the given experiments with problem definitions, solutions, observations and conclusions.	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5 Demonstrate ethical practices while performing lab experiments individually or in groups.	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

ADVANCE COMPUTER ARCHITECTURE LAB

PEC-ECE417-P

SYSTEM VERILOG

PEC-ECE402-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic of Signal and System

Sr. No.	Course outcomes At end of the semester : **Student will be able to**	RBT Level
CO-1	**Define** the terminology and fundamental principles, basic requirements related to learning the test bench language features for verification	LOTS: L1 (Remember)
CO-2	**Understand** how the language works with examples to build the test bench.	LOTS: L2 (Understand)
CO-3	**Apply** the basic constructs of language including coverage-driven, constrained-random, assertion, interface and test bench structure.	LOTS: L3(Apply)
CO-4	**Analyze** the guidelines and basic principles of language for building test benches, how and why to use classes, randomization, and functional coverage	HOTS: L4 (Analyze)
CO-5	**Evaluate** the results of various hardware verification methodologies like OVM, UVM.	HOTS: L5 (Evaluate)
CO-6	**Create** object-oriented test bench environment using hardware verification methodologies.	HOTS: L6 (Create)

Course Contents

UNIT- I

Unix/Linux-introduction, basic commands, directory handling, filters and piping, wildcards and regular expression, editors-vi/vim/gvim, basic shell programming, TCL, Perl and python scripting, various industry and academia tools for simulation, verification, synthesis.

UNIT- II

Introduction to design verification. Introduction to system Verilog, system Verilog components, system Verilog test bench, test bench components. test bench hierarchy. test bench architecture, design hierarchy, System- data types, operators, arrays. language constructs. procedural statements and flow control, process. Tasks and functions. classes, randomization and constraints

UNIT- III

Functional coverage, assertions. IPC, interface and test bench structures, array manipulation methods. multidimensional dynamic arrays. Static verification, formal verification of digital hardware, BDD based approach, functional equivalence. FSM verification, model checking,

UNIT- IV

System Verilog DPI, OVM. UVM methodologies, FPGA based Testing and Verification: Testing and Verification concept, Different level of verification, System level verification with system Verilog, Attributes of system Verilog, Fault coverage and ATPG based Testing, Boundary Scan and BIST based Testability, Case study using Verilog and System Verilog.

Text and Reference Books:

1. UNIX and Linux Handbook Paperback – Evi Nemeth, Garth Snyder. Trent R. Hein, Ben Whaley. Dan Mackin. Pearson. 2019
2. UNIX : Concepts and Applications.Sumitabha Das, 4th Edition. 2017
3. System Verilog for Verification- A Guide to Learning the Testbench Language Features, Third Edition. Springer, 2015
4. Essentials of Electronic Testing, M. L. Bushnell and V. D. Agrawal.3rd Kluwer Academic Publishers 2002
5. Delay Fault Testing for VLSI Circuits.A. Krstic and K-T Cheng,3rd Kluwer Academic Publishers. 2003
6. Testing of Digital Systems, N. K. Jha and S. Gupta, 2nd, Cambridge University Press. 2003
7. Digital Systems Testing and Testable Design, M. Abramovici, M. A. Breuer and A. D. Friedman. 3rd, Wiley-IEEE Press. 1994
8. Fault Tolerant and Fault Testable P. K. Lala. 4th, Hardware Design, Prentice-Hall.
9. All-in-One Electronics Simplified. A.K. Maini & Nakul Maini. Khanna Book Publishing.
10. Digital Design using Field Programmable Gate array by P.K.Chan,Samihamourad, Printice Hall Series
11. Digital System Designs And Practices: Using Verilog Hdl And FPGAs by Ming Bo lin. Wiley India Edition.
12. Algorithms for VLSI Design Automation, Sabih H. Gerez. Wiley. 2014
13. Principles of CMOS VLSI Design- A System and Circuit Perspective, Neil Weste, K Eshraghian, 2nd Edition, Pearson. 2001
14. Introduction to VLSI Design flow. Sneh Saurabh, Cambridge University Press.
15. Digital Design with an Introduction to Verilog HDL, M Morris Mano, Michael D. Ciletti. 5th Edition Pearson, 2017
16. Advanced FPGA Design. Rchitecture. Implementation. and Optimization, Steve Kilts. John Wiley and Sons, 2007

Website links

1. https://verificationguide.com systemverilog/systemverilog-tutorial/
2. https://chipverify.com systemverilog systemverilog-tutorial/

CO-PO Articulation Matrix of SYSTEM VERILOG (PEC-ECE402-T)															
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	Define the terminology and fundamental principles, basic requirements related to learning the test bench language features for verification. **LOTS: L1 (Remember)**	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2	Understand how the language works with examples to build the test bench. **LOTS: L2 (Understand)**	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3	Apply the basic constructs of language including coverage-driven, constrained-random, assertion, interface and test bench structure. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	Analyze the guidelines and basic principles of language for building test benches, how and why to use classes, randomization, and functional coverage. **HOTS: L4 (Analyze)**	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5	Evaluate the results of various hardware verification methodologies like OVM, UVM.**HOTS: L5 (Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6	Create object-oriented test bench environment using hardware verification methodologies. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
	Level of attainments:															

ROBOTICS

PEC-ECE404-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Control System Engineering

Sr. No.	Course outcomes: At end of the semester: **Student will be able to**	RBT Level
CO1	To describe the history, concepts and key components of robotics technologies.	LOTS: L1 (Remember)
CO2	To tell about various robot sensors and their perception principles that enable a robot to analyse their environment, reason and take appropriate actions toward the given goal.	LOTS: L2 (Understand)
CO3	To use the learned knowledge and skills in practical robotics applications.	LOTS: L3 (Apply)
CO4	To identify the problems in spatial coordinate representation and spatial transformation, robot locomotion, kinematics, motion control, localization and mapping, navigation and path planning.	HOTS: H4 (Analyse)
CO5	To plan, design and implement robotic systems, algorithms and software capable of operating in complex and interactive environments and also to develop robotic path motions and to use hydraulics and pneumatics in industrial robots	HOTS: H6 (Create)

ROBOTICS

PEC-ECE404-T

Course Content

UNIT-I

BASICS OF ROBOTICS

Robots and their applications: Robot subsystems, classification of robots, industrial applications Actuators and grippers: Electric actuators, hydraulic actuators, pneumatic actuators, selection of motors, grippers Sensors, vision and Signal conditioning: Sensor classification, internal sensors, external sensors, vision, signal conditioning, sensor selection.

UNIT-II

KINEMATICS AND DYNAMICS OF ROBOT

Kinematics: Forward position analysis, inverse position analysis, velocity analysis, link velocities, Jacobian computation, DeNOC, forward and inverse velocity analysis, acceleration analysis.

Dynamics: Inertia properties, Euler-Lagrange formulation, Newton-Euler formulation, recursive Newton- Euler algorithm, dynamic algorithms.

UNIT –III

LINEAR AND NONLINEAR CONTROLS FOR ROBOTS

Linear control: Control techniques, dynamic systems, transfer function and state space representation, robotic joint, performance and stability of feedback control, PID control of a moving block, selection of PID controller gains, state feedback control, joint controllers.

Nonlinear and force controls: Control of a moving block, multivariable robot control, stability of multi-DOF robot, linearized control, PD position control, computed torque control, feed forward control, robust control, adaptive control, Cartesian control, force control, hybrid control.

UNIT-IV

MOTION PLANNING AND CONTROL HARDWARE

Motion planning: Joint space planning, Cartesian space planning, path primitives, Cartesian trajectories, point to point vs continuous path planning.

Control hardware: Control considerations, hardware architecture, and hardware for joint controllers, computational speed.

TEXT BOOKS AND REFERENCE BOOKS:

1. S.K. Saha, "Introduction to Robotics", McGraw Hills
2. Mittal and Nagrath, "Robotics and Control", McGraw Hills
3. M. Odrey, "Industrial Robotics - SIE: Technology - Programming and Applications", McGraw Hills
1. S.K. Saha, "Dynamics of Three-Type Robotic Systems", Springer
2. I.J. Nagrath, "Control System Engineering", New Age International
3. R.S. Khurmi, "A Text Book of Engineering Mechanics", S. Chand

ROBOTICS

PEC-ECE404-T

CO-PO Articulation Matrix of ROBOTICS (PEC-ECE404-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 To describe the history, concepts and key components of robotics technologies.	3	3	2	2	-	3	1	-	2	1	-	3	3	2	2
CO2 To tell about various robot sensors and their perception principles that enable a robot to analyse their environment, reason and take appropriate actions toward the given goal.	3	3	2	2	-	3	2	-	2	1	-	3	3	2	2
CO3 To use the learned knowledge and skills in practical robotics applications.	3	3	3	3	-	3	2	1	2	2	-	3	3	3	3
CO4 To identify the problems in spatial coordinate representation and spatial transformation, robot locomotion, kinematics, motion control, localization and mapping, navigation and path planning.	3	3	3	3	-	3	1	1	1	1	-	3	3	3	3
CO5 To plan, design and implement robotic systems, algorithms and software capable of operating in complex and interactive environments and also to develop robotic path motions and to use hydraulics and pneumatics in industrial robots.	3	3	3	3	-	3	2	1	2	1	-	3	3	2	3
Level of attainments:															

ROBOTICS

PEC-ECE404-T

MICRO AND NANO ELECTRO MECHANICAL SYSTEM

PEC-ECE406-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic Engineering Physics, Analog & Digital Electronics.

Sr. No.	Course Outcome At the end of the semester, students will be able to:	RBT Level
CO-1	**Memorize** the terminologies used in MEMS.	LOTS: Level 1 (Remember)
CO-2	**Understand** basic approach to various fabrication techniques, their types and applications.	LOTS: Level 2 (Understand)
CO-3	**Apply** their understanding in fabrication process and characterization of MEMS.	LOTS: Level 3 (Apply)
CO-4	**Analyze** the performance of MEMS devices based on their characterization results.	HOTS: Level 4 & 5 (Analyze)
CO-5	**Design** various simple micro-devices.	HOTS: Level 6 (Create)

UNIT-1

Introduction to MEMS: New trends in Engineering and Science: Micro and Nanoscale systems, Overview of Nano and Microelectromechanical Systems. Introduction to Design of MEMS. Applications of Micro and Nanoelectromechanical systems. Microelectromechanical systems, devices and structures Definitions

UNIT-2

MICRO AND NANO ELECTRO MECHANICAL SYSTEM

PEC-ECE406-T

MEMS Fabrication: Overview of Microfabrication. Microfabrication Processes: Photolithography. Thin Film Deposition-PVD. CVD & Spin Coating. Sputtering. Etching technique- Wet & Dry. Doping. Wafer Dicing. Wafer Bonding.

UNIT-3

Case Study of MEMS product: Blood Pressure Senor (**NovaSensor BP sensor**). Background & History. Device design considerations. Acceleration sensors (**Analog devices & MEMSIC**). Background & History. Device design considerations. Gyros (InvenSense Gyro). Background & History. MEMS Gyro design.

UNIT-4

MEMS Characterization: Technologies for MEMS characterization. Scanning Probe Microscopy (SPM). Atomic Force Microscopy (AFM). Scanning Tunneling Microscopy (STM). Magnetic Force Microscopy. Scanning Electron Microscope.

TEXT BOOKS:

1. Eun Sok Kim. "Fundamentals of Microelectromechanical Systems (MEMS)". 1st ed. New York: McGraw Hill, 2021.
2. Chang Liu. "Foundation of MEMS", 2nd Edition. Pearson Education. 2012.
3. Tai-Ran Hsu. "MEMS and Microsystems: Design. Manufacture. and Nanoscale Engineering". 2nd edition. John Wiley & Sons Inc., 2008.
4. Madou. M.J.. "Fundamentals of Microfabrication: The Science of Miniaturization" Second Edition (2nd ed.). CRC Press. 2002.
5. N. Maluf and K. Williams. "An Introduction to Microelectromechanical Systems Engineering". 2nd Edition. Artech House. 2004.

CO-PO Articulation Matrix of MICRO AND NANO ELECTRO MECHANICAL SYSTEM (PCC-ECE406-T)															
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Memorize and Define the terminologies used in MEMS	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2	Understand & Explain basic approach to various fabrication techniques. their types and applications.	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3	Apply their understanding in fabrication process and characterization of MEMS.	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	Analyze & Summarize the performance of MEMS devices based on their characterization results.	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5	Design & Develop various simple micro-devices.	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
	Level of attainments.															

DIGITAL IMAGE PROCESSING

PCC-ECE408-T

General Course Information

Course Credits: 3 Type: PCC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability Theory, Mathematics.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	Define the terminology and fundamental principles related to digital image processing.	LOTS: L1 (Remember)
CO2	Understand image enhancement, restoration, segmentation, representation, description, compression, color processing algorithms.	LOTS: L2 (Understand)
CO3	Apply image enhancement, restoration, segmentation, representation, description, compression, color processing techniques.	LOTS: L3 (Apply)
CO4	Analyze performance digital image processing techniques.	HOTS: L4 (Analyze)
CO5	Design algorithms for image enhancement, restoration, segmentation, representation, description, compression and color image processing.	HOTS: L6 (Create)

Course Contents

UNIT-I

INTRODUCTION: What Is Digital Image Processing? The Origins of Digital Image Processing. Examples of Fields that Use Digital Image Processing. Fundamental Steps in Digital Image Processing. Components of an Image Processing System. Machine vision system.

DIGITAL IMAGE FUNDAMENTALS: Elements of Visual Perception: Structure of human eye, Brightness adaptation and discrimination. Light and the Electromagnetic Spectrum. Image Sensing and Acquisition. Image Sampling and Quantization. Digital Image Representation. Some Basic Relationships between Pixels. Mathematical Tools.

UNIT-II

IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN: Background. Some Basic Gray Level Transformations. Histogram Processing: Histogram Equalization. Histogram matching. Basics of Spatial Filtering: Spatial Correlation and Convolution. Smoothing Spatial Filters: Linear and non-linear. Sharpening Spatial Filters: The Laplacian, Unsharp Masking and Highboost Filtering.

IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN: Background. Introduction to the Discrete Fourier Transform. Frequency domain Filtering Fundamentals. Smoothing Frequency-Domain Filters. Sharpening Frequency Domain Filters.

UNIT –III

IMAGE RESTORATION: A Model of the Image Degradation/Restoration Process. Noise Models. Restoration in the Presence of Noise Only-Spatial Filtering: Mean Filters, order-statistic filters, adaptive filters. Periodic Noise Reduction by Frequency Domain Filtering. Estimating the Degradation Function. Inverse Filtering. Minimum Mean Square Error (Wiener) Filtering.

IMAGE SEGMENTATION: Detection of Discontinuities. Edge Linking and Boundary Detection. Thresholding. Region-Based Segmentation. Segmentation by Morphological Watersheds. The Use of Motion in Segmentation (in spatial domain).

UNIT-IV

COLOR IMAGE PROCESSING: Color Fundamentals. Color Models. Pseudocolor Image Processing. Color Transformations. Smoothing and Sharpening.

IMAGE COMPRESSION: Fundamentals. Image Compression Models. Basics compression methods: Huffman Coding, Arithmetic coding, LZW coding. Predictive Coding, Block Transform Coding.

REPRESENTATION AND DESCRIPTION: Representation. Boundary Descriptors. Regional Descriptors. Relational Descriptors.

TEXT BOOKS AND REFERENCE BOOKS:

1. Digital Image Processing. Gonzalez & Woods, PHI
2. Fundamentals of Digital Image Processing, Anil K Jain. Pearson.
3. Digital Image Processing. William K Pratt, Wiley.
4. Practical Image and Video Processing using MATLAB.Oge Marques. Wiley publications.
5. Fourier Methods in Imaging. Roger L. Easton. Wiley
6. Digital Signal Processing. Prokis. Pearson
7. Digital Signal Processing.Salivahanan. McGraw Hills

DIGITAL IMAGE PROCESSING

PCC-ECE408-T

CO-PO Articulation Matrix of DIGITAL IMAGE PROCESSING (PCC-ECE408-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 Define the terminology and fundamental principles related to digital image processing. **LOTS: L1 (Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 Understand image enhancement. restoration. segmentation. representation. description. compression. color processing algorithms. **LOTS: L2 (Understand)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 Apply image enhancement. restoration. segmentation. representation. description. compression. color processing techniques.**LOTS: L3 (Apply)**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4 Analyse performance digital image processing techniques.**HOTS: L4 (Analyse)**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 Design algorithms for image enhancement. restoration. segmentation. representation. description. compression and color image processing. **HOTS: L6 (Create)**	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of Attainment:															

PHOTONICS SYSTEMS

(PEC-ECE410-T)

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: EMT, Analog Electronics

Sr. No.	Course outcomes of: At end of the semester: Student will be able to	RBT Level
CO1	**Describe** terminologies & basics of photonic integrated circuits and devices.	LOTS: Level 1 (Remember)
CO2	**Understand** the concepts of waveguides, delay lines etc.	LOTS: Level 2 (Understand)
CO3	**Apply** the concepts of photonic circuits for different applications of photonics technology.	LOTS: Level 3 (Apply)
CO4	**Analyze** the performance of Integrated Photonics Devices and Circuits.	HOTS: Level 4 (Analyze)
CO5	**Design** basic photonics circuits in a better approach with detailed knowledge of Integrated Photonics.	HOTS: Level 6 (Create)

Course contents

Unit-I

Introduction to Photonic Integrated Circuits – Functional Building Blocks: Theory of Optical Waveguide – The Basic Building Block: Orthogonality Condition of Guided Modes, Principle of Single-Mode and Multimode Waveguides: Channel and Ridge Rib waveguides.

Unit-II

Coupled Mode Theory: Waveguide Distributed Bragg Reflector (DBR) and Sub-Wavelength Grating (SWG) waveguide: Mach-Zehender Interferometer (MZI) and Filters and Delay Lines.Fiber Bragg grating.

Unit-III

Practical Planar Lightwave Circuits and CMOS Compatible Silicon Photonics Technology Platforms: Thermo-Optic and Electro-Optic Switches; Reconfigurable Filters and Tunable Delay Lines, Concept of Field Programmable Photonic Gate Array.

Unit-IV

Integrated Optical High-Speed Modulators: Working Principle. EDFAs, Semiconductor optical amplifier. Directional Coupler (DC).

TEXT BOOKS AND REFERENCE BOOKS

1) Silicon Photonics – An Introduction, G.T. Reed. 1st edition. Wiley.
2) Photonics: Optical Electronics for Modern Communication. Yariv and Yeh 6th edition, Oxford.
3) Optoelectronic Integrated Circuit Design and Device Modeling. JianjunGao, 1st edition, Wiley.

INTEGRATED PHOTONICS DEVICES AND CIRCUITS

(PEC-ECE410-T)

CO-PO Articulation Matrix of PHOTONICS SYSTEMS (PEC-ECE410-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Describe terminologies & basics of photonic integrated circuits and devices.	3	3	2	1	1	2	3	1	2	1	1	1	2	2	2
CO2 Understand the concepts of waveguides, delay lines etc.	3	3	2	1	1	1	2	3	3	2	3	1	2	2	2
CO3 Apply the concepts of photonic circuits for different applications of photonics technology.	3	3	2	1	1	1	1	1	2	2	2	2	2	2	2
CO4 Analyze the performance of Integrated Photonics Devices and Circuits.	3	3	3	2	2	2	3	1	2	2	1	2	3	3	3
CO5 Design basic photonics circuits in a better approach with detailed knowledge of Integrated Photonics.	3	3	2	2	2	2	2	2	1	3	3	2	3	3	3
Level of Attainment:															

DATA ANALYTICS AND MINING

PEC-ECE412-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching Schedule L T P : 3 0 0 Examination Duration: 3 hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability Theory, Mathematics.

Sr. No.	CourseOutcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Define** the terminology and fundamental principles related data analytics and mining.	LOTS: L1 (Remember)
CO2	**Understand** various data mining techniques and algorithms.	LOTS: L2 (Understand)
CO3	**Apply**data mining techniques on real world or synthetic data.	LOTS: L3 (Apply)
CO4	**Analyze** performance of data mining techniques.	HOTS: L4 (Analyze)
CO5	**Design** data mining techniquesto solve real world problems.	HOTS: L6 (Create)

Course Contents

UNIT-I

Introduction: Kind of data that can be mined. Data Mining Functionalities. Technologies used in Data Mining. Applications of data Mining, Major Issues in Data Mining.
Data pre-processing: Need for preprocessing. Data Objects and Attribute types. Statistical description of data. Data Visualization: Pixel-Oriented. Geometric Projection, Icon-Based Visualization:
Measuring similarity and dissimilarity of data: Data Matrix versus Dissimilarity Matrix. Proximity Measures for Nominal Attributes, Proximity Measures for Binary Attributes. Dissimilarity of Numeric Data.

UNIT-II

Data cleaning, integration, reduction: wavelet transform. PCA, Attribute Subset Selection, regression and Log-Linear Models.
Data transformation and discretization: Data Transformation by Normalization. Discretization by Binning.

Discretization by Histogram Analysis. Discretization by Cluster, Decision Tree, and Correlation Analyses.
Data warehouse: Introduction. Data Warehouse and Database Systems. Data Warehouse Architecture. Data Warehouse Models. Extraction, Transformation, and Loading, Metadata Repository.

UNIT –III

Mining associations and correlations: basic concepts, Associations and Correlations. Mining Frequent Patterns, Apriori Algorithm Frequent Itemset Mining using Apriori Algorithm, Generating Association Rules from Frequent Itemsets. Improving efficiency of Apriori, Pattern Growth Approach for Mining Frequent Itemsets. Pattern evaluation Methods.

UNIT-IV

Classification: Introduction, General Approach to Classification, Classification using Decision Tree Induction. Bayesian Classification Methods. Rule Based Classification, Model Evaluation and Selection: Metrics for Evaluating Classifier Performance. Holdout Method and Random Subsampling, Cross-Validation.
Cluster analysis: Introduction, Basic Clustering Methods, Partitioning Methods, Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering, Distance Measures in Algorithmic Methods. BIRCH: Multiphase Hierarchical Clustering Using Clustering Feature Trees, Evaluation of Clustering.

TEXT BOOKS & REFERENCE BOOKS:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Morgan Kaufmann Publishers, Third Edition, July 2011.
2. Alex Berson, Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw Hill, 2004.
3. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2014.
4. K. P. Soman, Shyam Diwakar and V. Ajay, Insight into Data Mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2009.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, Prentice Hall of India, 2006.
6. Daniel T. Larose, Data Mining Methods and Models, Wiley, 2006.
7. W. H. Inman, Building the Data Warehouse, Wiley India, 2005.

CO-PO Articulation Matrix of DATA ANALYTICS AND MINING (PEC-ECE412-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Define the terminology and fundamental principles related data analytics and mining. **LOTS: L1 (Remember)**	1	1	1	1	_	_	_	_	1	_	_	1	2	2	2
CO2.Understand various data mining techniques and algorithms.**LOTS: L2 (Understand)**	1	1	1	1	_	_	_	_	1	_	_	1	2	2	2
CO3. Applydata mining techniques on real world or synthetic data. **LOTS: L3 (Apply)**	2	2	2	2	1	_	-	_	1	_	_	2	2	2	2
CO4. Analyze performance of data mining techniques. **HOTS: L4 (Analyse)**	3	3	3	3	1	_	2	_	1	_	_	3	3	3	3
CO5. Design data mining techniquesto solve real world problems. **HOTS: L6 (Create)**	3	3	3	3	2	_	2	_	2	_	_	3	3	3	3
Level of Attainment:															

SYSTEM VERILOG LAB

PEC-ECE402-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic of Digital Electronics

Sr. No.	Course outcomes: At end of the semester, Student will be able to	RBT Level
CO1	Apply theoretical knowledge of hardware verification techniques to various digital logic blocks.	LOTS: L3 (Apply)
CO2	Analyze the competency of test bench functional coverage on hardware in practical manner.	HOTS: L4 (Analyze)
CO3	Integrate knowledge of unix shell scripting, verification language features and constructs for functional modelling, coverage, equivalence, etc. and design interface and test bench structures for verification.	HOTS: L6 (Create)
CO4	Create test bench environment using hardware verification methodologies for digital hardware	HOTS: L6 (Create)
CO5	Demonstrate the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

SYSTEM VERILOG LAB

PEC-ECE402-P

LIST OF EXPERIMENTS

1. Familiarization with Unix/Linux basics, Unix shell programming and scripting
2. Test and verify the functionality of D-FF.
3. Test and verify the functionality of full adder.
4. Test and verify the functionality of register.
5. Test and verify the functionality of counter.
6. Test and verify the functionality of memory.
7. Initialize the last location in the array to a given value
8. Write a system Verilog program to declare static array and assign some value
9. Simulate and example of Array reduction methods-XOR
10. Array reduction methods SUM, PRODUCT using 'with' clause
11. Array reduction methods AND, OR and XOR using 'with' clause
12. Array reduction methods on Dynamic and Associative arrays
13. Design an interface and test bench for the data bus.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 14) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of SYSTEM VERILOG LAB (PEC-ECE402-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply theoretical knowledge of hardware verification techniques to various digital logic blocks. **LOTS: L3 (Apply)**	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2 **Analyze** the competency of test bench functional coverage on hardware in practical manner. **HOTS: L4 (Analyze)**	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3 **Integrate** knowledge of unix shell scripting, verification language features and constructs for functional modelling, coverage, equivalence, etc. and design interface and test bench structures for verification. **HOTS: L6 (Create)**	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4 **Create** test bench environment using hardware verification methodologies for digital hardware. **HOTS: L6 (Create)**	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5 **Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of attainments:															

ROBOTICS LAB

PEC-ECE404-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Control System Engineering

ROBOTICS LAB

PEC-ECE404-P

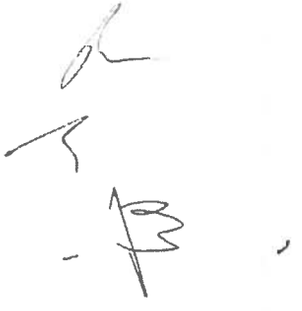
Sr. No.	Course outcomes: At end of the semester, Student will be able to	RBT Level
CO1	To explain the functionality and limitations of robot actuators and sensor.	LOTS: Level 2 (Understand)
CO2	To use programmable controllers for automation	LOTS: Level 3 (Apply)
CO3	To point out the effects of electronic circuits and sensors on automation controls.	HOTS: Level 4 (Analyse)
CO4	To test robotic systems to find out the faults	HOTS: Level 5 (Evaluate)
CO5	To generate programs for a robot to perform a specified task (e.g obstacle avoidance or wall following) in a target environment.	HOTS: Level 6 (Create)

LIST OF EXPERIMENTS

1. ADC and DAC interfacing with Micro-Controller
2. Temperature control using Micro-Controller interface
3. Stepper motor Interfacing with Micro-Controller
4. Servo motor Interfacing with Micro-Controller
5. LCD interfacing with Micro-Controller
6. Interfacing of PMW with DC motor using Micro-Controller interface
7. Study and selection of Gripper.
8. Study of robotic arm and its configuration
9. Study the robotic end effectors
10. Study of different types of hydraulic and pneumatic valves
11. Study of different actuators and end effectors for robot.
12. Robot programming and simulation for pick and place
13. Robot programming and simulation for Shape identification
14. Robot programming and simulation for Colour identification
15. Robot programming and simulation for multi process.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 11) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of ROBOTICS LAB (PEC-ECE404-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 To explain the functionality and limitations of robot actuators and sensor.	3	3	2	2	3	3	2	-	2	3	3	3	3	3	2
CO2 To use programmable controllers for automation	3	3	2	2	2	3	1	-	3	3	3	3	3	2	3
CO3 To point out the effects of electronic circuits and sensors on automation controls.	3	3	3	3	2	3	1	2	3	2	3	3	3	3	2
CO4 To test robotic systems to find out the faults	3	3	3	3	3	3	2	2	3	3	3	3	3	2	3
CO5 To generate programs for a robot to perform a specified task (e.g. obstacle avoidance or wall following) in a target environment.	3	3	3	3	2	3	1	2	2	3	3	3	3	3	3
Level of attainments:															



ROBOTICS LAB

PEC-ECE404-P

MICRO AND NANO ELECTRO MECHANICAL SYSTEM LAB

PEC-ECE406-P

General Course Information

Course Credits: 1 Type: PCC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments. the quality of solutions designed for the assignments. the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Engineering Physics, Analog & Digital Electronics.

S. No.	Course Outcomes: At the end of the semester, students will be able to:	RBT Level
CO1	**Understand** various concepts related to MEMS in simulation.	LOTS: L3 (Apply)
CO2	**Analyse** the different characterization techniques used for MEMS.	HOTS: L4 (Analyse)
CO3	**Integrate** the theoretical knowledge of MEMS with simulation.	HOTS: L6 (Create)
CO4	**Create** simulation of different MEMS structures.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while performing lab experiments individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Introduction to PVD thin film deposition technique.
2. Introduction to Sputtering technique for thin film deposition technique.
3. Simulation of cantilever.
4. Simulation of micro machined structures.
5. Introduction to FE-SEM as characterization technique.
6. Introduction to XRD for structural analysis.
7. Simulation of MEMS structure.
8. Simulation study of integration of circuits & MEMS.

NOTE: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of MICRO AND NANO ELECTRO MECHANICAL SYSTEM LAB (PEC-ECE406-P)															
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Understand various concepts related to MEMS in simulation.	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2	Analyze and evaluate the different characterization techniques used for MEMS	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3	Integrate the theoretical knowledge of MEMS with simulation.	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4	Create simulation of different MEMS structures.	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5	Demonstrate ethical practices while performing lab experiments individually or in groups.	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
	Level of attainments:															

DIGITAL IMAGE PROCESSING LAB

PEC-ECE408-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching Schedule L T P : 0 0 2	**Course Assessment Methods; Max Marks: 100 (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Programming Skills

S.No.	**Course Outcomes:** **By the end of the lab course a student would be able to:**	**RBT Level**
CO1	**Apply** modern programming tools to implement digital image processing techniques.	LOTS:L3 (Apply)
CO2	**Analyze** the performance of digital image processing techniques.	HOTS:L4 & L5 (Analyse & Evaluate)
CO3	**Devise** software solutions for common problems of image processing.	HOTS:L6 (Create)
CO4	**Create** written records for the given assignments with problem definition, design of solution and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

DIGITAL IMAGE PROCESSING LAB

PCC-ECE208-P

LIST OF EXPERIMENTS/ASSIGNMENTS

1. To familiarize with MATLAB software and Image Simulation and display.
2. Implementation of relationship between pixels.
3. Implementation of transformations of an image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
5. Display of FFT of an image.
6. Computation of mean, standard deviation, correlation coefficient of the given image.
7. Implementation of image smoothing filters.
8. Implementation of image sharpening filters.
9. Implementation of image intensity slicing techniques for image enhancement.
10. Implementation of edge detection algorithm.
11. Implementation of DCT/IDCT compression technique.

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of DIGITAL IMAGE PROCESSING LAB(PCC-ECE208-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Apply modern programming tools to implement digital image processing techniques. LOTS: L3 (Apply)	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2. Analyse and Evaluate the performance of digital image processing techniques. HOTS: L4& L5 (Analyse& Evaluate)	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3. Devise softwaresolutions for common problems of image processing. HOTS: L6 (Create)	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4. Create written records for the given experiments with problem definition, solution, observations and conclusions. HOTS: L6 (Create)	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5. Demonstrate ethical practices while performing lab experiments individually or in groups. LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

DIGITAL IMAGE PROCESSING LAB

PCC-ECE208-P

DIGITAL IMAGE PROCESSING LAB

PEC-ECE408-P

General Course Information

Course Credits: 1 Type: PE Mode: Practical(P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Programming Skills

S. No.	Course Outcomes: By the end of the lab course a student would be able to:	RBT Level
CO1	Apply modern programming tools to implement digital image processing techniques.	LOTS:L3 (Apply)
CO2	Analyze the performance of digital image processing techniques.	HOTS:L4 (Analyse)
CO3	Design software solutions for common problems of image processing.	HOTS:L6 (Create)
CO4	Create written records for the given assignments with problem definition, design of solution and conclusions.	HOTS: L6 (Create)
CO5	Demonstrate ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To familiarize with MATLAB software and Image Simulation and display.
2. Implementation of relationship between pixels.
3. Implementation of transformations of an image
4. Contrast stretching of a low contrast image, Histogram, and Histogram Equalization.
5. Display of FFT of an image.
6. Computation of mean, standard deviation, correlation coefficient of the given image.
7. Implementation of image smoothing filters.
8. Implementation of image sharpening filters.
9. Implementation of image intensity slicing techniques for image enhancement.
10. Implementation of edge detection algorithm.
11. Implementation of DCT/IDCT compression technique.

Software Required : MATLAB/PYTHON

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of IMAGE AND VIDEO PROCESSING LAB (PEC-ECE408-P)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Apply modern programming tools to implement digital image processing techniques. **LOTS: L3 (Apply)**	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2. Analyze the performance of digital image processing techniques. **HOTS: L4 (Analyze)**	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3. Design software solutions for common problems of image processing. **HOTS: L6 (Create)**	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4. Create written records for the given experiments with problem definition, solution, observations and conclusions. **HOTS: L6 (Create)**	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5. Demonstrate ethical practices while performing lab experiments individually or in groups. **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

PHOTONICS SYSTEMS LAB

PEC-ECE410-P

General Course Information

Course Credits: 1 Type: PE Mode: Practical(P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Communication systems, Electromagnetic Theory.

PHOTONICS SYSTEMS LAB

PEC-ECE410-P

Sr. No.	Course outcomes At the end of the semester, Students will be able to:	RBT Level
CO1	**Understand software** tools and apply these tools to write a program for photonics based applications.	LOTS: Levels 3 Apply
CO2	**Analyze** the outcomes of different experimental programs.	HOTS: Level 4 Analyse
CO3	**Evaluate** the performance of various optical components used to design photonic links & networks.	HOTS: Level 5 Evaluate
CO4	**Create** written records for the given experiments with problem definition, solution, observations & conclusion.	HOTS: Level 6 Create
CO5	**Demonstrate** ethical practices while performing lab experiments individually or in the group.	LOTS: Level 3 Apply

LIST OF EXPERIMENTS

1. To study the parameters of Single-Mode and Multimode Waveguides.
2. To study the parameters of FBG.
3. To study the parameters of Mach-Zehnder Interferometer/ Modulator.
4. To study the parameters of Electro-Optic Switches
5. To study the parameters of Lasers.
6. To study the parameters of EDFAs.
7. To study the parameters of DCF.
8. To study the parameters of APD and Receivers.
9. To design an Optical transmission link using optical components.
10. To ascertain BER for an Optical transmission link.

Note: At least 08 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of PHOTONICS SYSTEMS LAB (PEC-ECE410-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Understand software tools and apply these tools to write a program for photonics based applications	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2. Analyze the outcomes of different experimental programs.	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3. Evaluate the performance of various optical components used to design photonic links & networks.	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4. Create written records for the given experiments with problem definition, solution, observations & conclusion.	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5. Demonstrate ethical practices while performing lab experiments individually or in the group	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

DATA ANALYTICS AND MINING LAB

PEC-ECE412-P

General Course Information

Course Credits: 1 Type: PE Mode: Practical(P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments. the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Programming Skills

S. No.	**Course Outcomes:** **By the end of the lab course student would be able to:**	**RBT Level**
CO1	Apply modern data mining tools.	LOTS:L3 (Apply)
CO2	**Analyze** the performance of data mining techniques for classification and regression.	HOTS:L4 (Analyse)
CO3	**Design** software solutions for common classification and regression problems using data mining tool.	HOTS:L6 (Create)
CO4	**Create** written records for the given assignments with problem definition. design of solution and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

DATA ANALYTICS AND MINING LAB

PEC-ECE412-P

LIST OF EXPERIMENTS

1. Create a dataset with the help pf Data Mining Tool.
2. Explore data repository and select dataset to analyse using data mining tool.
3. Apply Pre-processing technique to the training data set using data Mining tool.
4. Apply Normalization techniques on given dataset.
5. To implement decision tree for classification on given dataset.
6. To explore visualization tools on given dataset.
7. Apply Cross-validation on a classification problem for given dataset.
8. To implement Clustering algorithm on given dataset.
9. To implement data reduction algorithms on given dataset.
10. To implement Linear Regression algorithm on given dataset.
11. To implement Logistic regression algorithm on given dataset.
12. To implement support vector machines on given dataset.
13. To implement Naïve Bayes algorithm on given dataset.
14. To implement K-NN algorithm on given dataset.

Software Required: PYTHON/WEKA/MS-EXCEL

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of DATA ANALYTICS AND MINING LAB(PEC-ECE412-P)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Apply modern data mining tools. **LOTS: L3 (Apply)**	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2. Analyze the performance of data mining techniques for classification and regression. **HOTS: L4 (Analyze)**	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3. Design software solutions for common classification and regression problems using data mining tool. **HOTS: L6 (Create)**	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4. Create written records for the given experiments with problem definition, solution, observations and conclusions. **HOTS: L6 (Create)**	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5. Demonstrate ethical practices while performing lab experiments individually or in groups. **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

ANALOG CMOS IC DESIGN

PEC-ECE414-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basic Electronics, Analog systems.

Sr.No.	Course outcomes At end of the semester Student will be able to:	RBT Level
CO1	**Remember** the concepts of Analog MOS devices and current mirror circuits.	LOTS: L1 (Remember)
CO2	**Understand** different configurations of Amplifiers and feedback circuits.	LOTS: L2 (Understand)
CO3	**Apply** the basic concepts of Analog MOS devices and current mirror circuits to build analog IC.	LOTS: L3 (Apply)
CO4	**Analyze** the characteristics of the frequency response of the amplifier and its noise.	HOTS: L4 (Analyze)
CO5	**Evaluate** the performance of the stability and frequency compensation techniques of Op- Amp Circuits.	HOTS: L5 (Evaluate)
CO6	**Create** different configurations of Amplifiers and feedback circuits.	HOTS: L6 (Create)

ANALOG CMOS IC DESIGN

PEC-ECE414-T

Course Contents

UNIT- I

Introduction to MOSFETS: Simple MOSFET circuits, Threshold voltage model, Capacitance model,Mobility model, MOSFET basics, Basic current mirrors, Cascade current mirrors, Active current mirrors with large and small signal analysis, MOSFET in integrated circuits, Common mode properties.

UNIT- II

Noise: Statistical characteristics of noise- Types of noise: significance of flicker and thermal.Analysis and representation of noise in single-stage amplifiers: CG, CS, CD (source follower)and cascode stage and noise in differential pairs. Representation of noise in circuits Noise in singlestage amplifiers- Noise in differential pairs-Noise Bandwidth.

UNIT- III

Feedback topologies (voltage-voltage, current-voltage, voltage-current, current-voltage) and the noise and the loading effect analysis, Negative feedback, Stability of negative feedback systems, Stability and frequency compensation: Specification analysis, multi-pole system, three-stage opamp, phase margin Frequency compensation, pole-zero doublet analysis.

UNIT- IV

Design of the CMOS operational amplifiers: One-stage opamps and two-stage opamps, Gain boosting techniques, folded cascade, telescopic amplifier, common mode feedback (CMFB) amplifier, Three-stage opamp architectures, opamp specifications analysis, Design of high-speed and high-gain amplifiers, CMOS amplifier Frequency response: Miller effect, common source (CS), common gate (CG), common drain (CD) stages, and cascode stage Analog layout techniques for MIM, MOM and fringe capacitor.

TEXT AND REFERENCE BOOKS:

1. "Design of Analog CMOS Integrated Circuits by Behzad Razavi, McGraw Hill Education (1September 2000).
2. CMOS Analog Circuit Design" by Phillip Allen and Douglas R. Holberg, OUP USA ; Third Edition edition (1 September 2011).
3. "Operation and Modeling of the MOS Transistor" by Yannis Tsividis, Oxford University Press; 2 edition, June 26, 2003.
4. "Microelectronic Circuits-Theory & Applications" by A.S. Sedra and K.C. Smith, Adapted by A.N. Chandorkar, 6th Edition, Oxford, 2013.
5. A.V.N. Tilak, Design of Analog Circuits, Khanna Publishing House, 2022

CO-PO Articulation Matrix of ANALOG CMOS IC DESIGN (PEC-ECE414-T)																
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Remember and realize the concepts of Analog MOS devices and current mirror circuits. **LOTS: L1 (Remember)**	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2	Understand different configurations of Amplifiers and feedback circuits. **LOTS: L2 (Understand)**	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3	Apply the basic concepts of Analog MOS devices and current mirror circuits to build analog IC. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	Analyze the characteristics of the frequency response of the amplifier and its noise. **HOTS: L4(Analyze)**	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5	Evaluate the performance of the stability and frequency compensation techniques of Op- Amp Circuits. **HOTS: L5(Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6	Create different configurations of Amplifiers and feedback circuits. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
	Level of attainments:															

WIRELESS SENSOR AND NETWORKS

PEC-ECE416-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures)L(Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100** **(Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks

Pre-requisites: Communication systems and Computer Networks

Sr. No.	Course Outcomes At the end of the semester, students will be able to	RBT Level
CO1	Outline the terminology, general architecture and application areas of wireless sensor networks.	LOTS: Level 1 Remember
CO2	Explain the working of WSNs with the help of various MAC, routing and transport control protocols.	LOTS: Level 2 Understand
CO3	Apply the knowledge gained to address the design issues and challenges involved in wireless sensor networks.	LOTS: Level 3 Apply
CO4	Analyze the working and performance of various WSN protocols and systems.	HOTS: Level 4 Analyze

Course Contents

UNIT-I

Introduction: Basic concept of WSN. Characteristic requirements for WSN. WSN vs Adhoc Networks. Challenges for WSNs. Application Examples; Sensor Node Architecture: Hardware components. Energy consumption, Examples of sensor nodes; Design principles of WSNs.

UNIT-II

MAC Protocols for WSN: Fundamentals of MAC Protocols, Low duty cycle protocols and wake-up concepts, Contention based Protocols, Schedule based protocols, IEEE802.15.4 MAC Protocol.

UNIT-III

Routing Protocols for WSN: Basics of Forwarding and Routing, Challenges and Design Issues. Gossiping and agent based unicast forwarding, Energy efficient unicast, Broadcast and Multicast, Geographic Routing, Mobile nodes. Data centring Routing, Data Aggregation.

UNIT-IV

Transport Control Protocols for WSN: Design Issues, Transport layer and QoS in WSN. Coverage and deployment, Reliability requirements, Single packet delivery, Block delivery, Congestion control and Rate control.

Design issues in Operating systems for WSNs and OS Examples: Security Considerations in WSNs.

TEXT AND REFERENCE BOOKS:

1. H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley and Sons, 2005.
2. K. Sohraby, Minoli, and T. Znati, "Wireless Sensor Networks: Technology, Protocols and Applications", John Wiley and Sons, 2007.
3. C.S. Raghavendra, K.M. Sivalingam and T. Zanti, "Wireless Sensor Networks", Springer Verlag, Sep. 2006.
4. W. Dargie, C. Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice," John Wiley & Sons, 2010.
5. E.H. Callaway Jr., "Wireless Sensor Networks: Architectures and Protocols", Auerbach Publications, CRC Press, 2004.

CO-PO Articulation Matrix of WIRELESS SENSOR AND NETWORKS (PEC-ECE416-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Outline the terminology, general architecture and application areas of wireless sensor networks. LOTS: L 1 (Remember)	3	2	-	-	-	-	-	-	-	1	1	3	3	1	1
CO2: Explain the working of WSNs with the help of various MAC, routing and transport control protocols. LOTS: L2 (Understand)	3	2	2	1	-	-	-	-	-	1	1	3	3	3	2
CO3: Apply the knowledge gained to address the design issues and challenges involved in wireless sensor networks. LOTS: L3 (Apply)	3	3	2	2	-	-	-	-	-	2	2	3	3	3	2
CO4: Analyze the working and performance of various WSN protocols and systems. HOTS: L4 (Analyze)	3	3	2	2	-	-	-	-	-	2	2	3	3	3	2

ADAPTIVE SIGNAL PROCESSING

PEC-ECE418-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures)L(Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Signals and Systems, Digital Signal Processing

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Describe** the significance of signal processing in the fields of filtering	LOTS: L1 (Remember)
CO2	**Understand** various digital & adaptive filters used in signal processing.	LOTS: L2 (Understand)
CO3	**Apply** adaptive algorithm for the analysis of adaptive filtering application	LOTS: L3 (Apply)
CO4	**Analyze** various filters for adaptive filtering application	HOTS: L4 (Analyze)
CO5	**Design** various types of applications through adaptive filter used in signal processing.	HOTS: L6 (Create)

ADAPTIVE SIGNAL PROCESSING

PEC-ECE418-T

Course Contents

UNIT-I

Design of Digital Filters: Introduction. Linear Time-Invariant Digital Filters. Recursive and Non-Recursive Filters. Filtering Operation. Sum of Vector Products. A Comparison of Convolution and Correlation. Filter Structures. Direct. Cascade and Parallel Forms. Linear Phase FIR Filters Design of Digital FIR Filter-banks. Sub-band Filters. Design of Infinite Impulse Response IIR filters. Issues in the Design and Implementation of a Digital Filter.

UNIT-II

The Filtering Problem. Adaptive Filters. Linear Filter Structure. Approaches to the development of Linear Adaptive Filtering Algorithms. Real and Complex form of Adaptive filters. Non-Linear Adaptive filters. Applications

UNIT-III

Wiener Filters. Linear Prediction. Kalman Filters. steepest descent algorithm. least mean square algorithm. frequency domain adaptive filters.

UNIT-IV

Adaptive echo cancellation. Principle of adaptive echo cancellation. Sub band acoustic echo cancellation. echo cancellation with linear prediction pre whitening. Stereophonic echo cancellation Performance evaluation of echo canceller. Adaptive noise cancellation. Adaptive line enhancer.

TEXT AND REFERENCE BOOKS:

1. Simon S Haykins. "Adaptive Filter Theory." PHI. 3rd Edition
2. Proakis. "Digital Signal Processing." PHI 2nd edition
3. Harry L. Van Trees. "Detection. Estimation. and Modulation Theory. Part 1&3." Wiley 2002
4. Saeed V. Vaseghi. "Advanced Digital Signal Processing and Noise Reduction." Third Edition.2006
5. Eberhard Hänsler. "Gerhard Schmidt Acoustic Echo and Noise Control. A Practical Approach." wiley. 2005.

ADAPTIVE SIGNAL PROCESSING

PEC-ECE418-1

CO-PO Articulation Matrix of ADAPTIVE SIGNAL PROCESSING (PEC-ECE418-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Describe the significance of signal processing in the fields of filtering. LOTS: L1 (Remember)	3	3	2	2	1	1	1	1	1	1	1	2	3	3	3
CO2. Understand various digital & adaptive filters used in signal processing. LOTS: L2 (Understand)	3	3	2	2	1	1	1	1	2	1	1	2	3	2	3
CO3. Apply adaptive algorithm for the analysis of adaptive filtering application LOTS: L3 (Apply)	3	2	2	1	1	1	2	1	2	1	2	2	3	2	3
CO4. Analyze various filters for adaptive filtering application HOTS: L4 (Analyze)	3	2	3	1	2	1	1	1	1	2	2	2	2	2	3
CO5. Design various types of applications through adaptive filter used in signal processing. HOTS: L6 (Create)	3	2	3	2	2	1	1	1	1	2	2	2	2	3	3
Level of attainments:															

WEB TECHNOLOGIES

PEC-ECE420-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Programming languages. Basic coding skills.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1.	**Illustrate** the Semantic Structure of HTML and CSS.	LOTS: L1 (Remember)
CO2.	**Describe** web pages using PHP.	LOTS: L2 (Understand)
CO3.	**Apply** Client-Side programs using JavaScript and Server-Side programs using PHP.	LOTS: L3 (Apply)
CO4.	**Design** web application using MVC architecture.	HOTS: L6 (Create)
CO5.	**Examine** JavaScript frameworks such as Query and Backbone.	HOTS: L4 (Analyze)

WEB TECHNOLOGIES

PEC-ECE420-T

Course Contents

UNIT I

HTML Basic Concepts: Good Web Design, Web Site Development Phases, HTML Documents Structure, Html Elements for Designing Pages, Text Level Events, Linking Basics, Linking in Html, Images and Anchors Attributes, Images, Images as Buttons, Introduction to Layout: Backgrounds, Colors and Text, Fonts, Layout with Tables, Advanced Layout: Frames and layers, HTML and other media types, FORMS, Forms Control, New and emerging Form Elements Layout Design, Advanced Layout.
Style Sheets, Positioning With Style Sheets, Basic Interactivity and Html: Forms, Forms Control, Advance HTML and Web Designing.

UNIT II

Information Architecture :The Role of the Information Architect, Collaboration and Communication, Organizing information, Organizational challenges, Organizing Web Sites and Intranets, Creating Cohesive Organization Systems, Designing Navigation Systems, Types of navigation Systems, Integrated Navigation Elements, Remote Navigation Elements, Designing Elegant Navigation Systems, Designing the Search Interface, Indexing the Right Stuff, Grouping Content, Conceptual Design: High-Level Architecture Blueprints, Architectural Page Mockups, Design Sketches.

UNIT III

Java Server Pages and Active Server Pages: Basics, Integrating Script, JSP/ASP Objects and Components, configuring and troubleshooting: Request and response objects, retrieving the contents of an HTML form, Retrieving a Query String, Cookies, Creating and Reading Cookies, Using application Objects and Events.

UNIT IV

Client-side programming: Introduction to the JavaScript syntax, the JavaScript object model, Event handling, Output in JavaScript, Forms handling, miscellaneous topics such as cookies, hidden fields, and images: Applications.Overview of advanced features of XML.XML Relationship between HTML, SGML, and XML, and The future of XML.

TEXT AND REFERENCE BOOKS:

1. Paul J. Deitel, Harvey M. Deitel, Abbey Deitel, Internet & World Wide Web How to Program, 5th edition, 2008.
2. Thomas A Powell, HTML-The Complete Reference, Tata McGraw Hill, 2003.
3. Pardi, XML in Action, Web Technology, PHI.
4. Web Technologies, Uttam K Roy, Oxford-University Press
5. The Complete Reference PHP – Steven Holzner, Tata McGraw-Hill
6. Web Programming, building internet applications, Chris Bates 2nd edition, Wiley Dremtech

CO-PO Articulation Matrix of WEB TECHNOLOGIES(PEC-ECE420-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Illustrate the Semantic Structure of HTML and CSS.	3	3	2	2	-	-	-	1	-	-	-	2	3	3	3
CO2. Describe web pages using PHP.	3	-	2	--	-	1	1	1	2	1	1	2	-	2	3
CO3. Apply Client-Side programs using JavaScript and Server-Side programs using PHP.	3	2	2	-	-	1	2	-	2	-	2	2	-	2	3
CO4. Design web application using MVC architecture.	3	-		1	2	-	1	-	1	2	2	2	2	2	3
CO5. Examine JavaScript frameworks such as Query and Backbone	3	2	3	2	2	-	1	-	1	-	2	-	-	3	3
Level of attainments:															

RADIO OVER FIBER

PEC-ECE422-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Communication Systems, Signals and Systems.

Sr.No.	Course outcomes: At end of the semester Student will be able to	RBT Level
CO1	**Describe** terminologies & basics of Radio over fiber systems.	LOTS: Level 1 Remember
CO2	**Understand** the concepts of signal transmission & reception in RoF networks.	LOTS: Level 2 Understand
CO3	**Apply** the concepts of RoF systems for different applications of wireless communications.	LOTS: Level 3 Apply
CO4	**Analyze** the performance of various types of RoF networks.	HOTS: Level 4 Analyze
CO5	**Design** basic RoF systems in a better fashion with thorough knowledge of optical transmission.	HOTS: Level 6 Create

RADIO OVER FIBER

PEC-ECE422-T

Course Contents

UNIT I

Introduction to Radio over Fiber: Concept of a Radio over Fiber System. Types of Transport. Types of Modulation. Types of Fiber. Subcarrier Multiplexing. Millimeter-Wave-over-Fiber Systems. System Component Effects. Improving System Performance. Applications of Radio over Fiber Technology.

UNIT II

Radio over Fiber Link Design Issues: Carrier Frequency. Channel Bandwidth. Number of Channels. Peak-to-Average-Power Ratio. Modulation Scheme. Uplink Power Control.

Example Link Design: Link Architecture. Optical Source and Receiver Types. Link Budget Calculations. EVM Measurements.

UNIT III

Semiconductor Lasers for Radio over Fiber Applications: Specifications of Semiconductor Lasers. Distributed Feedback Laser. Laser Static Characteristics. RIN Measurements. Modulation Bandwidth. Linearity. Applications of DFB Lasers in RoF Systems.

UNIT IV

Reflective Semiconductor Optical Amplifiers: Fundamentals of the RSOA. Outline of the RSOA Structure. RSOA Characteristics for a RoF Link. Limitations and Improvements.

Introduction to Radio over Free Space Optics (RoFSO): Basic architecture. signal impairments. applications.

TEXT AND REFERENCE BOOKS:

1. Nathan J. Gomes, Paulo P. Monteiro, "Next Generation Wireless Communications Using Radio Over Fiber" 1st edition. Wiley.
2. Xavier N Fernando, "Radio Over Fiber for Wireless Communications", 1st edition. Wiley.
3. Radio Over Fiber Technologies for Mobile Communications Networks By Hamed Al-Raweshidy, Shozo Komaki 2002
4. Radio Over Fiber Technologies for Wireless Communications Networks By Xavier N. Fernando 2014.
5. Radio over Fiber for Wireless Communications: From Fundamentals to Advanced Topics. Wiley-IEEE Press.

CO-PO Articulation Matrix of RADIO OVER FIBER (PEC-ECE422-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Describe terminologies & basics of Radio over fiber systems. (LOTS: Level 1 Remember)	3	1	1	2	--	--	--	--	--	--	1	1	3	2	2
CO2. Understand the concepts of signal transmission & reception in RoF networks. (LOTS: Level 2. understand)	3	2	3	3	2	--	--	--	--	--	2	3	3	2	2
CO3. Apply the concepts of RoF systems for different applications of wireless communications. (LOTS: Level 3. Apply)	2	3	2	2	3	3	1	1	2	--	2	2	2	3	3
CO4. Analyze the performance of various types of RoF networks. (HOTS: Level 4. Analyze)	2	2	2	2	3	3	1	1	1	--	1	1	1	3	3
CO5. Design basic RoF systems in a better fashion with thorough knowledge of optical transmission. (LOTS: Level 6. Create)	1	1	3	3	3	3	3	3	3	2	3	3	1	3	3
Level of attainments:															

RADIO OVER FIBER

PEC-ECE422-T

MULTIMEDIA TECHNOLOGIES

PEC-ECE424-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Data Communication and Networking.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1.	**Define** the characteristics of each media type and describe their application.	LOTS: L1 (Remember)
CO2.	**Understand** the key components of multimedia technologies including text, graphics, voice, video and animation.	LOTS: L2 (Understand)
CO3.	**Apply** the role of multimedia technologies in the online and web environment.	LOTS: L3 (Apply)
CO4.	**Develop** interactive web pages that incorporate a variety of digital media such as graphics, voice, animation and video.	HOTS: L6 (Create)
CO5.	**Analyze** the key components of multimedia technologies including text, graphics, voice, video and animation.	HOTS: L4 (Analyze)

MULTIMEDIA TECHNOLOGIES

PEC-ECE424-T

Course Contents

UNIT-I

Introduction to Multimedia Concepts. Types of Multi-media Applications. Methods to Deliver Multimedia. Introduction to Multimedia Database. Multimedia Input and Output Devices. Different stages of multimedia. the internet and multimedia. the stages of Multimedia Projects. Hardware and Software requirements

UNIT-II

Introduction about font and faces. Using Text in Multimedia.Applying different types of text in multimedia Font Editing and Design tools. Hypermedia and Hypertext application.

UNIT-III

The Power of images: Making Still Images. Coloring. and Image File Formats (GIF. JPEG. PNG etc.) The power of sound. MIDI vs. Digital Audio. Audio File Formats (AIFF. WAV. MPEG. MOV etc.) Adding Sound to multimedia projects.

UNIT-IV

Working of a Video and its Display: Digital Video Containers (Codecs & Video Format Converters) Obtaining Video Clips. Shooting and editing Video. Non-LinearEditing (NLE) in Videos.Authoring Systems Team for Multimedia Development.

TEXT AND REFERENCE BOOKS:

1. Tay Vaughan. Multimedia: Making It Work. Tata McGraw Hills. 2008.
2. James E Shuman. Multimedia in Action. Vikas Publishing House. 1997.
3. Andreas Holzinger. Multimedia Basics Technology. Volume 1. Firewall Media. 2005
4. Rangan Parekh. Principles of Multimedia. Tata McGraw Hills. 2007.
5. Multimedia Technologies. By D. A. Godse. Atul P. Godse

CO-PO Articulation Matrix of MULTIMEDIA TECHNOLOGIES (PEC-ECE424-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Define the characteristics of each media type and describe their application	3	1	1	2	--	--	--	--	--	--	1	1	3	2	2
CO2. Understand the key components of multimedia technologies including text, graphics, voice, video and animation	3	2	3	3	2	--	--	--	--	--	2	-	3	2	2
CO3. Apply the role of multimedia technologies in the online and web environment	-	3	2	2	3	3	1	1	2	--	2	2	-	3	3
CO4. Develop interactive web pages that incorporate a variety of digital media such as graphics, voice, animation and video.	2	-	2	-	3	3	1	1	1	--	1	1	1	3	3
CO5. Analyze the key components of multimedia technologies including text, graphics, voice, video and animation.	1	1	3	3	-	3	-	3	3	2	-	3	1	-	3
Level of attainments:															

CLOUD COMPUTING

PEC-ECE426-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100** **(Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Computer Network.

Sr. No.	Course outcomes: At end of the semester Student will be able to	RBT Level
CO1.	Define concepts related to cloud computing.	LOTS: Level 1 Remember
CO2.	Express deployment models for clouds.	LOTS: Level 2 Understand
CO3.	Apply cloud computing techniques for various applications.	LOTS: Level 3 Apply
CO4.	Analyse cloud computing services used at various levels.	HOTS: Level 4 Analyze
CO5.	Assess real time cloud services.	HOTS: Level 6 Evaluate

Course Contents

UNIT I

Introduction: Distributed Computing, Cluster Computing, Grid Computing, Overview of Cloud Computing, History of Cloud Computing, Defining a Cloud, Benefits of Cloud Computing, Cloud Computing Architecture, Services Models (XaaS), Infrastructure as a Service, Platform as a Service, Software as a Service.

CLOUD COMPUTING

PEC-ECE426-T

UNIT II

Deployment Models: Public Cloud, Private Cloud, Hybrid Cloud, Community Cloud, Dynamic Provisioning and Resource Management, Virtualization: Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Pros and Cons of Virtualization, Xen, VMware, Hyper-V

UNIT III

Cloud Platform in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services, Additional Services, Google App Engine- Architecture and Core Concepts, Application Life Cycle, Cost Model, Microsoft Azure – Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance.

UNIT IV

Cloud Application: Scientific Applications- ECG Analysis in cloud, Protein Structure Prediction, Gene Expression data analysis for Cancer Diagnosis, Satellite Image Processing, Business and Consumer Applications-CRM and ERP, Productivity, Social Networking, Media Applications, Multiplayer Online gaming, Cloud Security.

TEXT AND REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiola and S Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill Education Pvt. Ltd., 2013.
2. Kai Hwang, Geofferyu C. Fox and Jack J. Dongarra, Distributed and Cloud Computing, Elsevier, 2012.
3. John W. Ritting and James F. Ransome, Cloud Computing: Implementation Management and Security, CRCpress,2012
4. Cloud computing a practical approach - Anthony T.Velte , Toby J. Velte Robert Elsenpeter.• TATA McGraw- Hill , New Delhi – 2010
5. Cloud computing for dummies- Judith Hurwitz , Robin Bloor , Marcia Kaufman .Fern• Halper, Wiley Publishing, Inc, 2010
6. Cloud Computing (Principles and Paradigms), Edited by Rajkumar Buyya, James Broberg,• Andrzej Goscinski, John Wiley & Sons, Inc. 2011

CO-PO Articulation Matrix of CLOUD COMPUTING (PEC-ECE426-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1. Define concepts related to cloud computing. (LOTS: Level 1: Remember)	1	–	–	–	–	–	–	–	–	–	–	–	–	2	–
CO2. Express deployment models for clouds. (LOTS: Level 2: Understand)	1	–	–	–	–	–	–	–	–	–	–	–	–	3	–
CO3. Apply cloud computing techniques for various applications. (LOTS: Level 3: Apply)	2	2	2	–	2	–	–	–	–	–	–	–	–	3	–
CO4. Analyse cloud computing services used at various levels. (HOTS: Level 4: Analyse)	3	3	2	3	2	–	–	–	–	–	–	–	–	3	–
CO5. Assess real time cloud services. (HOTS: Level 5: Evaluate)	3	3	3	3	3	2	–	–	–	–	–	2	–	3	–
Level of Attainments :															

SYSTEM DESIGN USING FPGAs

PEC-ECE428-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks. will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment. the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination. nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Embedded systems.

Sr. No.	Course outcomes At end of the semester Student will be able to	RBT Level
CO1.	**Define** the basic requirements of implementations and realization of digital hardware for functional verification.	LOTS: L1 (Remember)
CO2.	**Understand** how to design digital system using top-down and Bottom-up approach.	LOTS: L2 (Understand)
CO3.	**Apply** the concepts of hardware simulation, synthesis and debugging techniques for FPGA implementation.	LOTS: L3 (Apply)
CO4.	Analyze the concepts of hardware simulation, synthesis and debugging techniques for FPGA implementation.	HOTS: L4 (Analyze)
CO5.	**Evaluate** and compare performance of digital hardware on FPGA.	HOTS: L5 (Evaluate)
CO6.	**Create** Testing and Verification environment for different logics using different methodologies.	HOTS: L6 (Create)

SYSTEM DESIGN USING FPGAs

PEC-ECE428-T

Course Contents

UNIT- I

Introduction: Evolution: PROM, PLA, PAL, Architecture of PAL's. Applications. Programming PLD's. Design Flow, Programmable Interconnections, Complex PLD's: CPLD. Why FPGA?. Applications, CAD Tools.

UNIT- II

Digital system Design: Top-down and Bottom-up approach to design. Case study, DataPath. Control Path. Controller behaviour and Design, Case study Mealy & Moore Machines .Timing of sequential circuits., Pipelining, Resource sharing, FSM issues (Starring state. Power on Reset. State diagram optimization, State Assignment, Asynchronous Inputs, Output Races, fault Tolerance).FPGA Architecture: FPGA family, Logic Block Architecture, Routing Architecture, Placement of blocks.

UNIT- III

FPGA implementation: Synthesis of design, Hardware debugging using Chipscope PRO. Power control/ process control systems using FPGA's, Design optimizations using Xilinx Plana head, DSP design flow using Xilinx FPGA's, Architecting- speed, area, and power, VLSI Micro-architecture Design. Timing Closure, High Throughput Computing; FPGA Based System Design, Processor Design

UNIT- IV

FPGA based Testing and Verification: Testing and Verification concept. Different level of verification, System level verification with system Verilog, Attributes of system Verilog. Fault coverage and ATPG based Testing. Boundary Scan and BIST based Testability

TEXT AND REFERENCE BOOKS:

1. Digital Design using Field Programmable Gate array by P.K.Chan. Samihamourad, Printice Hall Series
2. Digital System Designs and Practices: Using Verilog Hdland FPGAs by Ming Bo lin, Wiley India Edition.
3. Algorithms for VLSI Design Automation, Sabih H. Gerez. Wiley. 2014
4. Principles of CMOS VLSI Design- A System and Circuit Perspective. Neil Weste, K Eshraghian. 2nd Edition, Pearson, 2001
5. Introduction to VLSI Design flow, Sneh Saurabh. Cambridge University Press.
6. Digital Design with an Introduction to Verilog HDL. M-Morris-Mano. Michael D. Ciletti, 5th Edition. Pearson, 2017
7. Advanced FPGA Design architecture, Implementation, and Optimization. Steve Kilts, John Wiley and Sons, 2007
8. Architectures for Computer vision from Algorithm to Chip with Verilog. Hong Jeong. John Wiley and Sons, 2014

CO-PO Articulation Matrix of SYSTEM DESIGN USING FPGAs (PEC-ECE428-T)																
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Define the basic requirements of implementations and realization of digital hardware for functional verification. **LOTS: L1 (Remember)**	3	3	3	1	2	-	1	1	2	3	1	2	3	3	3
CO2	Understand how to design digital system using top-down and Bottom-up approach. **LOTS: L2 (Understand)**	3	3	-	1	2	2	1	1	3	3	1	2	3	3	3
CO3	Apply the concepts of hardware simulation, synthesis and debugging techniques for FPGA implementation. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	Analyze the concepts of hardware simulation, synthesis and debugging techniques for FPGA implementation. **HOTS: L4(Analyze)**	3	3	-	1	3	2	1	1	2	3	1	2	3	3	3
CO5	Evaluate and compare performance of digital hardware on FPGA. **HOTS: L5(Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6	Create Testing and Verification environment for different logics using different methodologies. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
	Level of attainments:															

MOBILE APPLICATION DEVELOPMENT

PEC-ECE430-T

General Course Information

Course Credits: 3 Type: PE Mode: Lectures (L) Teaching schedule L T P :3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100** **(Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: HTML, JavaScript, Java Programming and Object-Oriented programming,Knowledge of RDBMS and OLTP.

Sr. No.	Course outcomes: At end of the semester Student will be able to	RBT Level
CO1.	Describe basics of Android, its Evolution and its Architecture terminologies.	LOTS: Level 1 Remember
CO2.	Understand the Lifecycle of Software for Android Mobile Applications.	LOTS: Level 2 Understand
CO3.	Apply Mobile Applications on the Android Platform..	LOTS: Level 3 Apply
CO4.	Analyze Compare working with Buttons and other Widgets for Visual Environment.	HOTS: Level 4 Analyze
CO5.	Create Mobile Applications using data storage in SQLite Database and evaluate itsPerformance.	HOTS: Level 6 Create

Course Contents

UNIT- I

Mobile OS Architecture: Study various types of mobile OS- Android, Blackberry, Firefox, iOS, Pocket window, ARM and MIPS processor, Challenges of mobile platform, Android basic example, Dalvik VM, Software stack, Android core building blocks, Android emulator, Android manifest(.xml) and resource (.R) file, Hide title bar, Screen orientation.

UNIT - II

UI Widgets: Working with button, Toast, Custom toast, Button, Toggle button, Switch button, Image Button, Working with hardware button, checkbox, Alert dialog, Spinner, autocomplete textview, ratingbar, datepicker, timepicker, progressbar, Quick contact budge, Analog and digital clock, File download.

UNIT- III

Layout Manager: Relative layout, linear layout, table layout, grid layout.
Activity, Intent & Fragment: activity lifecycle, activity example, implicit and explicit intent.fragment lifecycle, fragment example, dynamic fragment.
Android menu: option menu, context menu, popup menu

UNIT - IV

Adaptor: Array adaptor, arraylist Adaptor, Base Adaptor.
View: Gridview, webview, scrollview, searchview, tabhost, dynamiclistview, Expanded listview.
SQLite: SQLite API, SQLite spinner, SQLite ListView
XML & JSON: XML parsing SAX, XML pull parser, JSON basics, JSON parsing.

TEXT AND REFERENCE BOOKS:

1. Bill Phillips et al., Android Programming - The "Big Nerd Ranch" Guide 2017
2. Ian F. Darwin, Problems and Solutions for Android Developers. Cookbook. O'Reilly. 2017
3. Redazione Io Programmo, Android Programming, 2011
4. John Horton, Android Programming for Beginners, packt publishing, 2015
5. Jason Wei, Android Database Programming, packt publishing, 2012

MOBILE APPLICATION DEVELOPMENT

PEC-ECE430-T

CO-PO Articulation Matrix of MOBILE APPLICATION DEVELOPMENT (PEC-ECE430-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1. Describe basics of Android, its Evolution and its Architecture terminologies.	2	1	3	2	–	–	–	–	1	–	–	1	2	2	2
CO2. Understand the Lifecycle of Software for Android Mobile Applications.	1	3	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3. Apply Mobile Applications on the Android Platform.	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4. Analyze Compare working with Buttons and other Widgets for Visual Environment.	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5. Create Mobile Applications using data storage in SQLite Database and evaluate itsPerformance.	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of attainments:															

CYBER SECURITY

PEC-ECE432-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Computer Networks, Operating System.

Sr. No.	Course Outcomes At end of the semester, Students will be able to	RBT Level
CO1	**Outline** the basics of cyber security, cyber crime and cyber law.	LOTS: L1 (Remember)
CO2	**Explain** various types of attacks and learn the tools to launch the attacks.	LOTS: L2 (Understand)
CO3	**Apply** techniques to identify different types of threats and attacks.	LOTS: L3 (Apply)
CO4	**Analyse** intrusion detection system.	HOTS: L4 (Analyze)
CO5	**Implement** intrusion prevention techniques to prevent intrusion.	HOTS: L6 (Create)

Course Contents

UNIT-I

INTRODUCTION: Cyber Security: History of Internet, Impact of Internet, CIA Triad; Reason for Cyber Crime, Need for Cyber Security, History of Cyber Crime; Cybercriminals, Classification of Cybercrimes, A Global Perspective on Cyber Crimes; Cyber Laws , The Indian IT Act, Cybercrime and Punishment.

UNIT-II

ATTACKS AND COUNTERMEASURES: Malicious Attack Threats and Vulnerabilities: Scope of Cyber Attacks, Security Breach, Types of Malicious Attacks, Malicious Software, Internet Worms, Spyware, Virus, Botnets, Phishing, DDoS Attack, Common Attack Vectors, Social Engineering Attacks, Wireless Network Attack, Web Application Attack, Attack Tools.

UNIT-III

INTRUSION DETECTION: Host based Intrusion Detection, Network based Intrusion Detection, Distributed or Hybrid Intrusion Detection, Intrusion Detection Exchange Format, Honey pots, Example System Snort.

UNIT-IV

INTRUSION PREVENTION: Firewalls and Intrusion Prevention Systems: Need for Firewalls, Firewall Characteristics and Access Policy, Types of Firewalls, Firewall Basing, Firewall Location and Configurations, Intrusion Prevention Systems, Example Unified Threat Management Products.

TEXT AND REFERENCE BOOKS:

1. Anand Shinde, "Introduction to Cyber Security Guide to the World of Cyber Security", Notion Press, 2021 .
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley Publishers, 2011
3. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones & Bartlett Learning Publishers, 2013.
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", Third Edition, Pearson Education, 2015.

CO-PO Articulation Matrix of Cyber Security (PEC-ECE432-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 **Outline** the basics of cyber security, cyber crime and cyber law. **LOTS: L1 (Remember)**	1	1	1	1	-	1	-	-	-	-	1	-	2	2	-
CO2 **Explain** various types of attacks and learn the tools to launch the attacks. **LOTS: L2 (Understand)**	1	3	1	3	2	1	-	-	-	-	-	-	2	2	-
CO3 **Apply** techniques to identify different types of threats and attacks. **LOTS: L3 (Apply)**	2	1	1	1	-	1	-	-	-	-	1	-	2	2	-
CO4 **Analyze** intrusion detection system. **HOTS: L4 (Analyse)**	3	3	2	2	2	1	-	-	-	-	-	-	2	2	-
CO5 **Implement** intrusion prevention techniques to prevent intrusion. **HOTS: L6 (Create)**	3	2	1	1	1	1	-	1	-	-	1	-	2	2	-
Level of attainments:															

NEURAL NETWORK AND DEEP LEARNING

PEC-ECE434-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Probability Theory, Mathematics.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Define & describe** the terminology and fundamental principles related to neural networks & deep learning.	LOTS: L1 (Remember)
CO2	**Understand & explain** architectures and learning techniques of various neural network and deep learning models.	LOTS: L2 (Understand)
CO3	**Apply** state-of-the-art neural network and deep learning architectures to solve problems.	LOTS: L3 (Apply)
CO4	**Evaluate** the performance of neural networks and deep learning methods.	HOTS: L5 (Evaluate)
CO5	**Design** neural network and deep learning architectures to solve problems.	HOTS: L6 (Create)

Course Contents

UNIT-I

INTRODUCTION: What is a Neural Network?. Human Brain. Model of a Neuron, Neural Networks viewed as directed graphs. feedback, network architectures. Learning processes/rules: Error Correction learning, memory based learning, Hebbian learning. competitive learning. boltzman learning. learning with a teacher. learning without a teacher.

NEURAL NETWORK MODELS: McCulloch-Pitts Neuron model, Single layer perceptron. Multilayer perceptron: Backpropagation algorithm. XOR problem. Cross-Validation, Network Pruning Techniques.

UNIT-II

RADIAN BASIS FUNCTION NETWORK: Cover's Theorem on the separability of patterns. Regularization Networks. Generalized Radial Basis Function Networks. Comparison of RBF networks and multilayer perceptron. XOR problem.

SELF ORGANIZING MAPS: Introduction. Self Organizing Feature Maps. Learning Vector Quantization (LVQ).

UNIT –III

DEEP LEARNING: Challenges motivating deep learning, Deep feed-forward networks: Output units. Hidden units. Regularization for deep learning. Dataset Augmentation, early stopping.

OPTIMIZATION ALGORITHMS: Stochastic Gradient Descent, Momentum, Nestrov Momentum. Parameter initialization strategies. Algorithms with adaptive learning rates: AdaGrad. RMSProp. Adam.

UNIT-IV

CONVOLUTIONAL NETWORKS: The convolution operation, motivation, Layers: Convolutional layer. activation layer, pooling layer. Fully connected layers, dropout layer, convolutional network architectures: LeNet-5. AlexNet, GoogLeNet. ResNet.

RECURRENT NEURAL NETWORKS: Recurrent Neurons, Recurrent Neural Networks, Back propagation through time. Bidirectional RNNs. Deep Recurrent Networks, LSTM.

TEXT AND REFERENCE BOOKS:

1. Neural Networks: A comprehensive Foundation, Simon Haykin, Pearson Education.
2. Introduction to Neural Networks. Sivanandam, S Sumathi, S N Deepa, TATA McGraw HILL.
3. Deep Learning. Goodfellow I., BengioY., and Courville A., MIT Press.
4. Hands on Machine Learning with Scikit-Learn &Tensor Flow, Aurelien Geron. O'Reilly Media Inc.
5. Neural Networks – A Classroom Approach, Satish Kumar, Tata McGraw-Hill
6. Neural Networks. Fuzzy Logic and Genetic Algorithms. Rajasekaran and G.A. Vijayalakshmi Pai. PHI Learning .
7. Artificial Neural Networks. B.Yegnanarayana. PHI Learning .

CO-PO Articulation Matrix of Neural Network and Deep Learning (PEC-ECE434-T)															
List of Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1 **Define & describe** the terminology and fundamental principles related to neural networks & deep learning. **LOTS: L1 (Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 **Understand & explain** architectures and learning techniques of various neural network and deep learning models. **LOTS: L2 (Understand)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 **Apply** state-of-the-art neural network and deep learning architectures to solve problems. **LOTS: L3 (Apply)**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4 **Evaluate** the performance of neural networks and deep learning methods. **HOTS: L5 (Evaluate)**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 **Design** neural network and deep learning architectures to solve problems. **HOTS: L6 (Create)**	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of attainments:															

BATTERY MANAGEMENT SYSTEM

PEC-ECE436-T

General Course Information

Course Credits: 3 Type: PEC Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Electrical Technology.

Sr. No.	Course outcomes At end of the semester: Students will be able to	RBT Level
CO1	**Define** the terminology and fundamental principles, basic requirements related of battery management system.	LOTS: L1 (Remember)
CO2	**Describe** how to estimate the battery and define communication interface in BMS model.	LOTS: L2 (Understand)
CO3	**Apply** the basic concepts and effect of charge control on battery performance and charging Circuits.	LOTS: L3 (Apply)
CO4	**Analyze** the guidelines and procedures for evaluating battery degradation and parameter monitoring.	HOTS: L4 (Analyze)
CO5	**Evaluate** the effect of charge control on battery performance and charging circuits.	HOTS: L5 (Evaluate)
CO6	**Create** the battery model for different applications and a monitoring system.	HOTS: L6 (Create)

Course Contents

UNIT-I

BATTERY MANAGEMENT SYSTEM (BMS): Introduction, Needs, Advantages, Functions, BMS Required in Energy Storage System, PLC Based BMS, Microprocessor Based BMS, Microcontroller Based BMS, Topological Structure of BMS, System Failures Due to the Absence of BMS, General BMS development flow for electric vehicles.

UNIT-II

ESTIMATION OF A BATTERY AND COMMUNICATION INTERFACE: Introduction, Battery Degradation, Battery Life & then relationship, Procedures for Evaluating Battery Degradation, Battery

Degradation Diagnosis (online and offline), Communication Interface for BMS, BMS Communication Bus and Protocols, Higher-Layer Communication Protocols, Battery Data Transmission Mode.

UNIT-III

BATTERY CHARGER: Introduction, Charge Control Methods, Effect of Charge Control on Battery Performance, Charging Circuits: Half-Bridge and Full-Bridge Circuits, ON-Board Charger, Off-Board Charger, Fast Charger, Ultra-Fast Charger, Infrastructure Development and Challenges, Isolation and Safety Requirement for Chargers.

UNIT-IV

BATTERIES, FLYWHEELS AND SUPERCAPACITORS: Introduction, Battery Parameters, Lead Acid Batteries Nickel-Based Batteries, Sodium-Based Batteries, Lithium Batteries, Metal-Air Batteries Supercapacitors & Flywheels, Choice of Battery, Battery Modelling.

TEXT AND REFERENCE BOOKS:

1. Xiaojun Tan, Andrea Vezzini, Yuqian Fan, Neeta Khare, You Xu, Liangliang Wei, "Battery Management System and its Applications" John Wiley & Sons Ltd, China Machine Press, Wiley Publication, 2023.
2. Shichun Yang, Xinhua Liu, Shen Li, Cheng Zhang, "Advanced Battery Management System for Electric Vehicle", Springer Nature, Huazhong University of Science and Technology Press, 2023
3. Ibrahim Dinçer, Halil S. Hamut, Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", Wiley Publication, 2017.
4. James Larminie and John Lowry, "Electric Vehicle Technology Explained", John Wiley & Sons Ltd. 2nd Edition, Wiley Publication, 2012.

BATTERY MANAGEMENT SYSTEM

PEC-ECE436-T

CO-PO Articulation Matrix of Battery Management System (PEC-ECE436-T)															
	List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**Define** the terminology and fundamental principles, basic requirements related of battery management system. **LOTS: L1 (Remember)**	3	3	3	1	2	2	1	1	2	3	1	2	3	3	3
CO2	**Describe** how to estimate the battery and define communication interface in BMS model. **LOTS: L2 (Understand)**	3	3	3	1	2	2	1	1	3	3	1	2	3	3	3
CO3	**Apply** the basic concepts and effect of charge control on battery performance and charging Circuits. **LOTS: L3 (Apply)**	3	3	2	1	3	2	1	1	3	3	1	2	3	3	2
CO4	**Analyze** the guidelines and procedures for evaluating battery degradation and parameter monitoring. **HOTS: L4 (Analyze)**	3	3	2	1	3	2	1	1	2	3	1	2	3	3	3
CO5	**Evaluate** the effect of charge control on battery performance and charging circuits. **HOTS: L5 (Evaluate)**	2	2	2	1	3	2	1	1	2	3	1	2	2	2	2
CO6	**Create** the battery model for different applications and a monitoring system. **HOTS: L6 (Create)**	3	3	3	1	3	2	1	1	2	3	2	2	3	3	3
Level of attainment:																

CLOUD COMPUTING LAB

PEC-ECE426-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-Requisites: Basic knowledge of Java, C#.

Sr. No.	Course outcomes At end of the semester, Students will be able to	RBT Level
CO1	**Configure** various virtualization tools such as Virtual Box, VMware workstation.	LOTS: L3 (Apply)
CO2	**Design** and **deploy** a web application in a PaaS environment.	HOTS: L6 (Create)
CO3	**Learn** how to simulate a cloud environment to implement new schedulers.	LOTS:L2(Understand)
CO4	**Install** and use a generic cloud environment that can be used as a private cloud.	HOTS: L6 (Create)
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in	LOTS: L3 (Apply)

	groups.	

LIST OF EXPERIMENTS

1. Install Virtualbox/ VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 6 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of Cloud Computing Lab (PEC-ECE426-P)															
	List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**Configure** various virtualization tools such as Virtual Box, VMware workstation. **LOTS: L3 (Apply)**	3	-	-	-	3	-	1	1	-	-	-	-	-	2	-
CO2	**Design** and **deploy** a web application in a PaaS environment. **HOTS: L6 (Create)**	2	-	3	-	3	2	1	1	2	1	-	-	-	3	2
CO3	**Learn** how to simulate a cloud environment to implement new schedulers. **LOTS:L2 (Understand)**	1	-	-	2	-	-	1	1	2	1	-	-	-	-	2
CO4	**Install** and use a generic cloud environment that can be used as a private cloud. **HOTS: L6 (Create)**	-	-	3	-	3	2	1	1	2	1	-	-	-	2	2
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	2	2	1	1	3	-	1	1	2	2	2
Level of attainments:																

CLOUD COMPUTING LAB

PEC-ECE426-P

SYSTEM DESIGN USING FPGAs LAB

PEC-ECE428-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-Requisites: Digital Electronics, Microprocessor and Logic Design, Digital System Design.

Sr. No.	Course outcomes At end of the semester, Students will be able to	RBT Level
CO1	**Apply** theoretical knowledge of Programming and implementation of PLDs for digital logics.	LOTS: L3 (Apply)
CO2	**Evaluate** the competency of FPGAs for digital system design.	HOTS: L5 (Evaluate)
CO3	**Integrate** knowledge of HDL features and constructs for digital hardware functional modelling and synthesis and **design** interface for FPGA implementation and programming.	HOTS: L6 (Create)
CO4	**Create** testbench and FPGA programming environment hardware design.	HOTS: L6 (Create)
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

SYSTEM DESIGN USING FPGAs LAB

PEC-ECE428-P

LIST OF EXPERIMENTS

1. Programming and implementation of PLDs.
2. Design and implementation of Code Converters.
3. Design and implementation of Decoder, Encoders, priority encoder.
4. Design and implementation of Multiplexer/ Demultiplexers.
5. Design and implementation of Adders/ Subtractors.
6. Design and implementation of Flip Flops, Shift Registers, Universal Shift Registers.
7. Design and implementation of Counters.
8. Design and implementation of Memories.
9. Design and implementation of Multipliers.
10. Design and implementation of ALU.
11. Design of BIST.
12. Implementation of any 4 (Four) digital circuit on FPGA board.

Note: At least 10 experiments are to be performed in the semester, out of which minimum 7 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus. The students must prepare Mini Project (Ex. No. 13) in the group of two-three students before the semester ends.

CO-PO Articulation Matrix of System Design using FPGAs Lab (PEC-ECE428-P)															
	List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**Apply** theoretical knowledge of Programming and implementation of PLDs for digital logics. **LOTS: L3 (Apply)**	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2	**Evaluate** the competency of FPGAs for digital system design. **HOTS: L5 (Evaluate)**	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3	**Integrate** knowledge of HDL features and constructs for digital hardware functional modelling and synthesis and design interface for FPGA implementation and programming. **HOTS:L6(Create)**	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4	**Create** testbench and FPGA programming environment hardware design. **HOTS: L6 (Create)**	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of attainments:																

MOBILE APPLICATION DEVELOPMENT LAB

PEC-ECE430-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified performas (attached herewith as Annexure I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Java programming, Object-oriented programming, RDBMS and OLTP

Sr. No.	Course Outcomes At end of the semester, Students will be able to	RBT Level
CO1	**Apply** Android programming concepts for calling, display, creation and validation	LOTS: L3 (Apply)
CO2	**Generate** solutions for content providers and permissive models.	HOTS: L6 (Create)
CO3	**Compare** the visual effects generated by Android and visual studio frameworks.	HOTS: L4 (Analyze)
CO4	**Design** applications for Android Programming by using Android Studio framework.	HOTS: L6 (Create)
CO5	**Create** lab record of the solutions for assignment.	HOTS: L6 (Create)
CO6	**Demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Create basic application to display "Hello Students" message in center with red text and white background.
2. Create sample application with login module. Validate it for login screen or alert the user with a Toast.
3. Create and validate a login application using username as Email ID else login button must remain disabled.
4. Create a Login application and open a browser with any one search engine.
5. Create an application to print your name multiple time as number provided in input.
6. Create spinner to display date of semester practical where label value change accordingly.
7. Create an application to change screen color as per the user choice from a menu.
8. Create a background application that will open activity on specific time.
9. Create an application to display an array of images using grid.
10. Create an application to store student recoded in list and display.
11. Design an application to open gjust.ac.in web page.
12. Create an application to call a phone number entered by the user in the Edit Text box.
13. Create an application that will create database to store username and password.
14. Create an application to insert, update and delete a record from the database.
15. Write a program to read and Parse a JSON File.

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of Mobile Application Development Lab (PEC-ECE430-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply Android programming concepts for calling, display, creation and validation. LOTS: L3 (Apply)	1	1	1	1	-	1	-	-	-	-	1	-	2	2	-
CO2 Generate solutions for content providers and permissive models. HOTS: L6 (Create)	1	3	1	3	2	1	-	-	-	-	-	-	2	2	-
CO3 Compare the visual effects generated by Android and visual studio frameworks. HOTS: L4 (Analyze)	2	1	1	1	-	1	-	-	-	-	1	-	2	2	-
CO4 Design applications for Android Programming by using Android Studio framework. HOTS: L6 (Create)	3	3	2	2	2	1	-	-	-	-	-	-	2	2	-
CO5 Create lab record of the solutions for assignment. HOTS: L6 (Create)	3	2	1	1	1	1	-	1	-	-	1	-	2	2	-
CO6 Demonstrate ethical practices, independent enquiry and self-learning to solve unseen problems. LOTS: L3 (Apply)	3	2	1	1	2	1	-	1	-	-	-	-	2	2	-
Level of attainments:															

CYBER SECURITY LAB

PEC-ECE432-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified performas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-Requisites: Computer Networks, Data Communication.

Sr. No.	Course Outcomes At the end of the semester, Students will be able to:	RBT Level
CO1	**Apply** the theoretical knowledge to implement the basics of cyber security	LOTS: L3 (Apply)
CO2	**Generate** cyber attacks, threats and intrusion,and implement the ways to detect and defend them.	HOTS: L6 (Create)
CO3	**Analyze** the different types of attacks and threats in terms of different parameters	HOTS: L4 (Analyze)
CO4	**Create** lab record of the solutions for assignment.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices, independent enquiry and self-learning to solve unseen problems.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1.Install Kali Linux.

2. Explore Kali Linux.

3. Implement and demonstrate Denial of service (DoS) attack.

4. Implement the Botnet attack detection using publically available dataset.

5. Explore and install Snort Intrusion Detection Tool.

6. Implement Firewall rules using Snort.

7. Generate the network attack using Snort.

8. Detect the attack using Snort.

9. Perform real-time network traffic analysis and data pocket logging using Snort.

10. View the alerts and logs to detect any malicious activity using snort.

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of Cyber Security Lab(PEC-ECE432-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply the theoretical knowledge to implement the basics of cyber security. LOTS: L3 (Apply)	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2 Create cyber attacks, threats and intrusion and implement the ways to detect and defend them. HOTS: L6 (Create)	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3 Analyze the different types of attacks and threats in terms of different parameters HOTS: L4 (Analyze)	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4 Create lab record of the solutions for assignment.) HOTS: L6 (Create)	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5 Demonstrate ethical practices, independent enquiry and self-learning to solve unseen problems. LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of Attainments:															

NEURAL NETWORK AND DEEP LEARNING LAB

PEC-ECE434-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified proformas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Basic Programming Skills.

S.No.	**Course Outcomes:** **By the end of the lab course a student would be able to:**	**RBT Level**
CO1	**Apply** modern programming tools to implement neural networks and deep learning models.	LOTS: L3 (Apply)
CO2	**Analyze** the performance of neural network and deep learning models.	HOTS: L4 (Analyse)
CO3	**Devise** software solutions for common problems of classification and regression.	HOTS: L6 (Create)
CO4	**Create** written records for the given assignments with problem definition, design of solution and conclusions.	HOTS: L6 (Create)
CO5	**Demonstrate** ethical practices while solving problems individually or in groups.	LOTS: L3 (Apply)

NEURAL NETWORK AND DEEP LEARNING LAB

PEC-ECE434-P

LIST OF EXPERIMENTS/ASSIGNMENTS

1. Write a program for classification of linearly separable data with a perceptron model.
2. Write a program for classification of an XOR problem with a multilayer perceptron network.
3. Write a program for classification of a 4-class problem with a multilayer perceptron network.
4. Write a program for classification of an XOR function using backpropagation algorithm.
5. Write a program for classification of an XOR problem using Radial basis function networks.
6. Write a program for implementation of self organizing maps.
7. Explore Neural Network Toolbox for pattern recognition problem.
8. Explore Deep Learning Toolbox functions for image data.
9. Explore Deep Learning Toolbox functions for time series and sequence data.
10. Explore Keras library functions for deep learning implementation.
11. Write a program to implement Convolutional Neural Network for image data.
12. Write a program to implement Convolutional Neural Network for 1-D data.
13. Write a program to implement transfer learning from a pre-trained network on given dataset.
14. Write a program for time-series forecasting using deep learning.

Software Required: MATLAB/PYTHON

Note: At least eight experiments are to be performed in the semester, out of which at least six experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed & set by the concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix: Neural Network and Deep Learning Lab (PEC-ECE434-P)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Apply modern programming tools to implement neural networks and deep learning models. **LOTS: L3 (Apply)**	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2 Analyze the performance of neural network and deep learning models. **HOTS: L4 (Analyze)**	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3 Devise software solutions for common problems of classification and regression. **HOTS: L6 (Create)**	2	1	3	1	2	2	1	-	3	-	2	2	3	2	3
CO4 Create written records for the given experiments with problem definition, solution, observations and conclusions. **HOTS: L6 (Create)**	-	-	-	-	-	2	1	3	3	3	3	2	-	-	2
CO5 Demonstrate ethical practices while performing lab experiments individually or in groups. **LOTS: L3 (Apply)**	-	-	-	-	-	2	1	3	3	3	3	3	-	-	2
Level of attainments:															

BATTERY MANAGEMENT SYSTEM LAB

PEC-ECE436-P

General Course Information

Course Credits: 1 Type: PEC Mode: Practical (P) Teaching schedule L T P :0 0 2	**Course Assessment Methods (Internal: 50; External: 50)** The internal and external assessment is based on the level of participation in laboratory sessions, timely submission of experiments/assignments, the quality of solutions designed for the assignments, the performance in VIVA-VOCE, the quality of laboratory file and ethical practices followed. There will be a continuous process for laboratory course evaluation. Two internal examinations (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE II) will be conducted in the week before or after the internal examinations for the theory courses. The overall internal marks will be calculated as the average of the two minor laboratory course evaluations. The course coordinator will conduct these minor evaluations in the slots assigned to them as per their timetable. The Chairperson of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE II must be submitted within a week of the conduct of these laboratory course evaluations. The external examination will be conducted by external examiner appointed by the Controller of Examination along with the internal examiner, preferably the lab course coordinator, appointed by the Chairperson of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. The Course Coordinator / Internal Examiners/ External Examiners will maintain and submit the bifurcation of marks obtained by the students in their respective internal/external evaluations in the specified performas (attached herewith as Annexures I and II) to the respective departments in addition to the submitting and uploading of overall marks on the university portal as per the requirement of the result branch. The laboratory course coordinator will also conduct laboratory course exit survey and, compute and submit the attainment levels of the laboratory course based on direct and indirect evaluation components and submit it to the Chairperson office along with the internal assessment marks.

Pre-requisites: Electrical Technology.

Sr. No.	Course Outcomes At end of the semester, Students will be able to	RBT Level
CO1	**Apply** theoretical knowledge of how to monitor cell voltage and temperature.	LOTS: L3 (Apply)
CO2	**Analyze** the state-of-charge and state-of-health of the battery.	HOTS: L4 (Analyze)
CO3	**Integrate** knowledge of power electronics circuit that connects the pack with the controls.	HOTS: L6 (Create)
CO4	**Create** the model of battery packs using electrical networks using MATLAB.	HOTS: L6 (Create)
CO5	**Demonstrate** the records for the given experiments with problem definition, solution, observations and conclusions individually or in groups.	LOTS: L3 (Apply)

BATTERY MANAGEMENT SYSTEM LAB

PEC-ECE436-P

LIST OF EXPERIMENTS

1. To monitor cell voltage and temperature.
2. To understand the power flow in a bidirectional converter.
3. To estimate state-of-charge and state-of-health.
4. To model battery packs using electrical networks.
5. To build Simple Model of Battery Pack in MATLAB.
6. To design and perform the V-I characteristics of cascaded 5V battery connection.
7. To design the power electronics circuit that connects the pack with the controls.
8. To design state observers for state-of-charge and state-of-health online estimation.
9. To study IoT based Battery Management System.
10. To develop a simulink model for battery management system using MATLAB.

Note: At least 8 experiments are to be performed in the semester, out of which minimum 6 experiments should be performed from above list. Remaining experiments may either be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

CO-PO Articulation Matrix of Battery Management System Lab (PEC-ECE436-P)															
List of Course Outcomes		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	Apply theoretical knowledge of how to monitor cell voltage and temperature. **LOTS: L3 (Apply)**	3	2	2	1	2	1	1	1	2	1	1	2	3	2	3
CO2	Analyze the state-of-charge and state-of-health of the battery. **HOTS: L4 (Analyze)**	3	2	2	1	2	1	1	1	2	1	1	2	2	3	3
CO3	**Integrate** knowledge of power electronics circuit that connects the pack with the controls. **HOTS: L6 (Create)**	2	3	2	1	3	1	1	1	2	1	1	2	2	3	3
CO4	**Create** the model of battery packs using electrical networks using MATLAB. **HOTS: L6 (Create)**	3	3	3	1	2	1	1	1	2	1	1	2	2	2	2
CO5	**Demonstrate** the records for the given experiments with problem definition. solution. observations and conclusions individually or in groups. **LOTS: L3 (Apply)**	1	1	1	1	1	1	1	1	3	1	1	2	2	2	2
Level of attainments:																

BATTERY MANAGEMENT SYSTEM LAB

PEC-ECE436-P

INTRODUCTION TO INTERNET OF THINGS (IoT)

OE-ECE-391-T

General Course Information

Course Credits: 3 Type: OE Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre- requisites: Data Communication, Computer Networks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	**Outline** the general concepts and terminology related to internet of Things and applications.	LOTS:L1 (Remember)
CO 2	**Understand** various protocols used in IoT.	LOTS: L2 (Understand)
CO 3	**Apply** suitable hardware and interfaces for IoT deployments.	LOTS: L3 (Apply)
CO 4	**Analyse** different types of devices and software used in IoT.	HOTS: L4 (Analyse)
CO 5	**Design** and **develop** smart city and other applications using IoT.	HOTS: L6 (Create)

Course Contents

UNIT-1

INTRODUCTION: Definition and characteristics of IoT, Physical Design of IoT, Logical Design of IoT, Basic steps of IoT, IoT Design methodology enabling technologies, M2M basics, Difference between IoT and M2M, Software defined networking, network function virtualization.

UNIT-2

IOT PHYSICAL DEVICES: Basic building blocks of an IoT device, Exemplary Devices – Raspberry Pi, Arduino, Arduino board details, Analog, digital and PWM pins, Arduino IDE software, SPI and I2C communications.

UNIT-3

INTERFACING: Interfacing LED, LCD, Humidity Sensor, Temperature Sensor with Arduino, Programs to interface sensors to Arduino, Interfacing motors.

UNIT-4

CASE STUDIES: Smart lighting, Home intrusion detection, smart parking system. Air pollution monitoring. Smart irrigation.

TEXT BOOKS:

1. Arshdeep Bahga, Vijay Madisetti. Internet of Things: A Hands-on approach. Universities press
2. Internet of Things, Principles and Paradigms: Rajkumar Buyya, Elsevier
3. K.G.Srinivasa, G.M.Siddesh, Internet of Things. Cengage
4. Mcewen. Hakin Cassimally, Designing the internet of Things, Wiley
5. David Hanes, Gonzalo Salagueiro. IoT Fundamentals, CISCO
6. The Internet of Things: From RFID to the Next-Generation Pervasive Networked LuYan, Yan Zhang. Laurence T. Yang, Huansheng Ning.

CO-PO Articulation Matrix of Introduction to Internet of Things (IoT) OE-ECE-391-T															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Outline the general concepts and terminology related to internet of Things and applications. LOTS:L1 (Remember)	3	2	3	2	3	1	-	1	2	2	2	3	3	3	3
CO2 Understand various protocols used in IoT. LOTS: L2 (Understand)	3	2	3	1	2	1	-	1	2	1	2	3	2	3	3
CO3 Apply suitable hardware and interfaces for IoT deployments. LOTS: L3 (Apply)	3	3	3	3	2	1	-	1	2	2	2	2	2	3	2
CO4 Analyse different types of devices and software used in IoT. HOTS: L4 (Analyse)	3	3	3	3	2	1	-	1	3	2	2	2	3	2	2
CO5 Design and develop smart city and other applications using IoT. HOTS: L6 (Create)	3	3	3	3	2	1	-	1	3	2	2	2	3	2	2
Level of attainments:															

DRONE AND ANTI-DRONE TECHNOLOGY

OE-ECE392-T

General Course Information

Course Credits: 3 Type: OE Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of electronics, Fundamentals of Mechanical engineering

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	**Define** the terminologies and fundamental principles related to UAV, Drone and Anti-Drone.	LOTS: L1 (Remember)
CO2	**Understand and explain** the operation of components & various design units of drone and Anti-Drone systems.	LOTS: L2 (Understand)
CO3	**Apply** the knowledge of technical and operational requirements for drone and anti-drone.	LOTS: L3 (Apply)
CO4	**Analyze** the performance parameters of Drone and Antidrone subsystems.	HOTS: L4 (Analyze)
CO5	**Evaluate** the parameters of Drone and Antidrone subsystems for a given application.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

INTRODUCTION TO UAV AND PAYLOAD: Unmanned Aerial Vehicle, Historical aspects of UAV, classification of UAVs, applications, Deployment Restriction on UAVs, Small UAVs, system composition, Introduction to design and selection of the system: conceptual design, preliminary design, detail design, selection of the system, Payload: dispensable and non-dispensable payload, types of payload: cargo freight, Surveillance, military, scientific.

UNIT -II

UAV DESIGN AND NAVIGATION: Lift-induced drag, rotary wing aerodynamics, airframe configuration: HTOL, VTOL, hybrids (convertible rotor aircraft, tilt-wing). Design for stealth: acoustic, visual, radio, and radar signatures. Inertial navigation system, GPS, elements of guidance system, guidance laws, Line-of-Sight guidance law, waypoint guidance.

UNIT -III

DRONE DESIGN, SAFETY AND REGULATIONS: Introduction to drone and their applications. India and drones, tinkering and drones. classification of drone-based on their structure. Dynamics of an aerial system, Stability and Control, drone sensors: Accelerometer. Barometer. Gyro Sensor. Magnetometer. thermal. chemical, distance sensors. Propulsion and vertical motion. batteries of drone. building your own drone. Key features of Drone Regulations 1.0. Future of drones.

UNIT -IV

INTRODUCTION TO ANTI -DRONE TECHNOLOGY: Introduction. The need for anti-drone systems. system requirement. drone detection, identification. localization and tracking. drone neutralization, Jamming and countering techniques. anti-drone system guidelines: detector deployment. threat level assessment. Risk management. advances in drone technology: anti-drone nullification technology. anti-drone system advances. Challenges in countering.

TEXT AND REFERENCE BOOKS:

1. Unmanned Aircraft Design: A Review of Fundamentals. Synthesis Lectures on Mechanical engineering. By Mohammad Sadraey. Morgan & Claypool Publishers series.2017.
2. Unmanned Aircraft Systems: UAVs Design. Development and Deployment By Reg Austin, Wiley, 2010.
3. Theory. Design and Applications of Unmanned Aerial Vehicles By A. R. Jha. CRC Press. 2016.
4. Survey on Anti-Drone Systems: Components. Designs. and Challenges By Seongjoon Park, Hyeong Tae Kim. Sangmin Lee. Hyeontae Joo , and Hwangnam Kim.
5. Counter-Drone Systems, The Center for the Study of the Drone at Bard College By Arthur Holland Michel.
6. ATL Drone Module. https://aim.gov.in/pdf/ATL_Drone_Module.pdf.

CO-PO Articulation Matrix of Drone and Anti-Drone Technology (OE-ECE392-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Define the terminologies and fundamental principles related to UAV, Drone and Anti-Drone. **LOTS: L1(Remember)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO2 **Understand and explain** the operation of components & various design units of drone and Anti-Drone systems. **LOTS: L2 (Understand)**	1	1	1	1	–	–	–	–	1	–	–	1	2	2	2
CO3 **Apply** the knowledge of technical and operational requirements for drone and anti-drone. **LOTS: L3 (Apply)**	2	2	2	2	1	–	-	–	1	–	–	2	2	2	2
CO4 Analyze the performance parameters of Drone and Antidrone subsystems.**HOTS: L4 (Analyze)**	3	3	3	3	1	–	2	–	1	–	–	3	3	3	3
CO5 **Evaluate** the parameters of Drone and Antidrone subsystems for a given application. **HOTS: L5 (Evaluate)**	3	3	3	3	2	–	2	–	2	–	–	3	3	3	3
Level of attainments:															

INTRODUCTION TO 5G/6G TECHNOLOGY

OE-ECE-491-T

General Course Information

Course Credits: 3 Type: OE Mode: Lectures (L) Teaching schedule L T P : 3 0 0 Examination Duration:03 Hours	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** Three minor tests, each of 20 marks, will be conducted. The third minor will be conducted in open book mode by the Course Coordinator. No date sheet will be issued for the third minor at the level of the Departments. For the purpose of internal assessment, the average of the highest marks obtained by a student in any two minor examinations will be considered. All the minor examination question papers will be prepared and evaluated by following the Outcome Based Education framework. Class Performance will be measured through percentage of lectures attended (4 marks) Assignments (4 marks) and class performance (2 marks). The end semester examination will be of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Communication System

Sr. No.	**Course Outcomes:** **At the end of the semester, students will be able to:**	**RBT Level**
CO1	**Define** the significance of communication in daily life.	LOTS: L1 (Remember)
CO2	**Explain** the evolution of mobile communication & technologies over the years.	LOTS: L2 (Understand)
CO3	**Use** the theory of communication in different scenario.	LOTS: L3 (Apply)
CO4	**Compare** the speed of LTE and 5G/6G in cellular communication.	HOTS: L4 (Analyze)
CO5	**Evaluate** various types of applications of 5G, 6G and advanced techniques in cellular communications.	HOTS: L5 (Evaluate)

Course Contents

UNIT-1

Evolution from 1G to 5G, LTE features and architecture, introduction to 5G communication, architecture, New Radio, massive MIMO, potentials and applications of 5G, usage scenarios, Spectrum for 5G – 5G deployment, Challenges and Applications.

UNIT-2

Enhanced mobile broadband(eMBB), ultra reliable low latency communication(uRLLC), massive machine type communication(MMTC), D2D communication, V2X communication, spectrum for 5G, spectrum access/sharing, millimeter wave communication .

UNIT-3

OFDM, Non-Orthogonal Multiple Access (NOMA), carrier aggregation.5G NR requirements - 5G Core Network Architecture - Radio-Access Network (RAN)- Radio Protocol Architecture -User Plane Protocols, Control Plane Protocols - Network Slicing- RAN virtualization .

UNIT-4

6G current research & initiatives, 6G Opportunities & applications, 6G networks, 6G security, 6G challenges.

TEXT AND REFERENCE BOOKS:

1. 6G: The Road to the Future Wireless Technologies 2030, Ramjee Prasad, River Publishers Series.
2. Wireless Communications Systems Architecture Transceiver Design and DSP Towards 6G, Khaled Salah Mohamed, Springer.
3. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies, CRC Press, 1st Edition, 2019.
4. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", Academic Press, 1st Edition, 2018.
5. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", John Wiley & Sons, 1st Edition, 2015.
6. Long Zhao, Hui Zhao, Kan Zheng, Wei Xiang, "Massive MIMO in 5G Networks: Selected Applications", Springer, 1st Edition, 2018.
7. Robert W. Heath Jr., Angel Lozano, "Foundations of MIMO Communication", Cambridge University Press, 1st Edition, 2019.
8. R. Vannithamby and S. Talwar, "Towards 5G: Applications, Requirements and Candidate Technologies", John Willey & Sons, 1st Edition, 2017.

CO-PO Articulation Matrix of Introduction to 5G/6G Technology (OE-ECE-491-T)															
List of Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1 Define the significance of communication in daily life. LOTS: L1 (Remember)	3	2	2	1	-	-	-	-	-	1	1	3	3	2	3
CO2 Explain the evolution of mobile communication & technologies over the years. LOTS: L2 (Understand)	3	2	2	1	-	1	-	-	-	1	1	3	3	3	3
CO3 Use the theory of communication in different scenario. LOTS: L3 (Apply)	3	2	3	1	-	-	-	-	-	1	2	3	3	3	3
CO4 Compare the speed of LTE and 5G/6G in cellular communication. HOTS: L4 (Analyze)	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
CO5 Evaluate various types of applications of 5G, 6G and advanced techniques in cellular communications. HOTS: L5 (Evaluate)	3	3	2	1	-	1	-	-	-	1	2	3	3	3	2
Level of attainments:															

INRODUCTION TO 5G/6G TECHNOLOGY

OE-ECE-491-T