Learning Outcomes based Curriculum Framework (LOCF)

For

B. Tech. (Electronics and Communication Engineering)

III to VIII semester

Faculty of Engineering and Technology

Chaudhary Devi Lal University Sirsa-125055

2022-2023

Program outcomes (POs) and Program Specific Outcomes (PSOs)

Program outcomes (POs) of Bachelor Programs in Engineering and Technology have been specified in First year common curriculum of B.Tech. Program. Program Specific Outcomes (PSOs) are given as:

PSO1	To prepare the students to understand electronic and communication systems, components and processes to address technical and engineering challenges
PSO2	To empower the students to build up career in industry or pursue higher studies in ECE or interdisciplinary courses
PSO3	To enhance the skills of the students with the ability to implement the scientific concepts for betterment of the society considering ethical, environment and social values.

Course Code	**Definition/ Category**
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management Courses
MC	Mandatory Courses
PC	Program Core
PE	Program Elective Courses
OE	Open Elective Courses
EEC	Employability Enhancement Courses (Project work/ Summer Training/ Industrial Training/ Practical Training/ Internship/Seminar, etc.)

Semester	Basic Science Courses (BSC)		Engineering Science Courses/ Program Core Courses/ Program Elective Courses/ Open Elective Courses/ Employability Enhancement Courses (ESC/PC/PE/OE/EEC)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses (MC)		Grand Total Credit
Sr. No.	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	
3rd	01	03	07	16	00	00	01	00	19
4th	00	00	09	20	01	00	01	00	20

Course Code	Course Title	Workload/Credit			
	Semester III	Theory	Tutorial	Practical	Total
BSC/7-T	Mathematics-III	3/3	-	-	3/3
PC/ECE/1-T	Digital Electronics	3/3	-	-	3/3
PC/ECE/2-T	Analog Electronics-I	3/3	-	-	3/3
PC/ECE/3-T	Network Analysis and Synthesis	3/3	-	-	3/3
PC/ECE/4-T	Analog Communication	3/3	-	-	3/3
PC/ECE/1-P	Digital Electronics Lab	-	-	2/1	2/1
PC/ECE/2-P	Analog Electronics-I Lab	-	-	4/2	4/2
PC/ECE/3-P	Network Analysis and Synthesis Lab	-	-	2/1	2/1
*MC/3-T	Indian Constitution	3/0	-	-	3/0
	Total	18/15	-	8/4	26/19

Course Code	Course Title	Workload/Credit			
	Semester IV	Theory	Tutorial	Practical	Total
PC/ECE/5-T	Sensors and measuring Instruments	3/3	-	-	3/3
PC/ECE/6-T	Digital Communication and Information theory	3/3	-	-	3/3
PC/ECE/7-T	Analog Electronics -II	3/3	-	-	3/3
PC/ECE/8-T	Electromagnetic Theory	3/3	-	-	3/3
PC/ECE/9-T	Signals and Systems	3/3	-	-	3/3
PC/ECE/5-P	Sensors and measuring Instruments Lab	-	-	2/1	2/1
PC/ECE/6-P	Analog and Digital Communication Lab	-	-	2/1	2/1
PC/ECE/7-P	Analog Electronics-II Lab	-	-	4/2	4/2
PC/ECE/10-P	Problem Solving using MATLAB	-	-	2/1	2/1
*MC/4-T	Essence of Indian Traditional Knowledge	3/0	-	-	3/0
**HSMC/2-T	Human Values and Personality Development	3/0	-	-	3/0
Total		21/15	-	10/5	31/20

* Non-credit qualifying mandatory course.

**Non-credit qualifying mandatory course. The assessment will be completely internal.

***The students will have to undergo Industrial Training/Internship-I for 4-6 weeks during summer vacations after the examination of 4th semester which will be evaluated in 5th semester.

Note: Students will be allowed to use non-programmable scientific calculators only, however, sharing of calculator should not be permitted.

Semester	Basic Science Courses (BSC)		Engineering Science Courses/ Program Core Courses/ Program Elective Courses/ Open Elective Courses/ Employability Enhancement Courses (ESC/PC/PE/OE/EEC)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses (MC)		Grand Total Credit
Sr. No.	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	
5th	00	00	08	24	01	03	00	00	27
6th	00	00	09	19	01	02	00	00	21

Course Code	Course Title	Workload/Credit			
	Semester V	Theory	Tutorial	Practical	Total
PC/ECE/11-T	Microprocessors and Microcontrollers	3/3	1/1	-	4/4
PC/ECE/12-T	Digital Signal Processing	3/3	1/1	-	4/4
PC/ECE/13-T	Control System Engineering	3/3	1/1	-	4/4
PC/ECE/14-T	Computer Architecture and Organization	3/3	-	-	3/3
Open Elective Course-I to be opted by students from another branch		3/3			3/3
PC/ECE/11-P	Microprocessors and microcontrollers lab	-	-	2/1	2/1
PC/ECE/12-P	Digital Signal Processing Lab	-	-	2/1	2/1
HSMC/3-T	Fundamentals of Management	3/3	-	-	3/3
*EEC/ECE/1-P	Industrial training/Internship-I	-	-	-/4	-/4
Total		17/17	2/2	4/6	25/27

*Assessment of Industrial training/Internship-I will be based on presentation/seminar, viva-voce, report and certificate for the practical training taken at the end of IV 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.

Course Code	Course Title	Workload/Credit			
	Semester VI	Theory	Tutorial	Practical	Total
PC/ECE/15-T	Computer Networks & IoT	3/3	-	-	3/3
PC/ECE/16-T	VLSI design	3/3	-	-	3/3
PC/ECE/17-T	Microwave and Radar Engineering	3/3			3/3
PE/ECE/1-T to PE/ECE/4-T	Program Elective Course-I	3/3	-	-	3/3
Open Elective Course-II to be opted by students from another branch		3/3	-	-	3/3
PC/ECE/15-P	Computer Networks & IoT Lab	-	-	2/1	2/1
PC/ECE/16-P	VLSI design Lab	-	-	2/1	2/1
PC/ECE/17-P	Microwave Engineering Lab	-	-	2/1	2/1
PC/ECE/18-P	Skill and Innovation Lab	-	-	2/1	2/1
HSMC/4-T	Economics for Engineers	2/2	-	-	2/2
Total		17/17	-	8/4	25/21

* The students will have to undergo **Industrial Training/Internship-II of 6 to 8 weeks** duration during summer vacations which will be evaluated in VII sem. Under the supervision of faculty during VII semester.

Note:- Program Elective Course-I has to be chosen by students from the list offered by ECE Department.

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

Students will be allowed to use the scientific calculator only.

Program Elective Course-I (Sem 6)

Sr.No.	Code	Subject
1.	PE/ECE/1-T	Consumer & industrial electronics
2.	PE/ECE/2-T	Linear integrated circuits and applications
3.	PE/ECE/3-T	Recent trends in communication systems
4.	PE/ECE/4-T	Data structure and algorithm

Credit Scheme for B. Tech. Electronics and Communication Engineering

4th year (7th & 8th Semester)

Semester	Basic Science Courses (BSC)		Engineering Science Courses/ Program Core Courses/ Program Elective Courses/ Open Elective Courses/ Employability Enhancement Courses (ESC/PC/PE/OE/EEC)		Humanities, Social Sciences Courses (HSMC)		Mandatory Courses (MC)		Grand Total Credit
Sr. No.	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	**No. of Courses**	**Total Credits**	
7th	0	0	10	24	0	0	0	0	24
8th	0	0	4	17	0	0	0	0	17

Course Code	Course Title	Workload/Credit			
	Semester VII	Theory	Tutorial	Practical	Total
PC/ECE/19-T	Digital System Design	3/3	-	-	3/3
PC/ECE/20-T	Mobile Communication and Networks	3/3	-	-	3/3
PE/ECE/5-T to PE/ECE/8-T	Program elective course-II	3/3	-	-	3/3
PE/ECE/9-T to PE/ECE/12-T	Program elective course-III	3/3	-	-	3/3
Open elective course-III to be opted by students from another branch		3/3	-	-	3/3
PE/ECE/5-P to PE/ECE/8-P	Program elective course-II Lab	-	-	2/1	2/1
PC/ECE/19-P	Digital System Design Lab			2/1	2/1
*EEC/ECE/3-P	Minor Project	-	-	8/4	8/4
**EEC/ECE/4-P	Industrial training/Internship-II	-	-	4/2	4/2
***EEC/ECE/5-P	Seminar	-	-	2/1	2/1
Total		15/15	-	18/9	33/24

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

Program Elective Course-II, Program Elective Course-II Lab, Program Elective Course-III has to be chosen by students from the list offered by ECE Department.

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

*** Select a topic relevant to ECE domain and suitable for UG Level presentation. Present the selected topic with superiority demonstrating good communication skills

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

Program Elective Course-II (Sem7)

Sr.No.	Code	Subject
1.	PE/ECE/5-T	FPGA Design
2.	PE/ECE/6-T	Optical Communication
3.	PE/ECE/7-T	Embedded System Design
4.	PE/ECE/8-T	Operating System
5.	PE/ECE/5-P	FPGA Design Lab
6.	PE/ECE/6-P	Optical Communication Lab
7.	PE/ECE/7-P	Embedded System Design Lab
8.	PE/ECE/8-P	Operating System Lab

Program elective course-III (Sem7)

Sr.No.	Code	Subject
1.	PE/ECE/9-T	Wireless Sensor Networks
2.	PE/ECE/10-T	Speech and Audio Processing
3.	PE/ECE/11-T	WLAN and Security
4.	PE/ECE/12-T	Bio Medical Electronics

Course Code	Course Title	Workload/Credit			
	Semester VIII	Theory	Tutorial	Practical	Total
PE/ECE/13-T to PE/ECE/16-T	Program Elective Course-IV	3/3		-	3/3
PE/ECE/17-T To PE/ECE/20-T	Program Elective Course-V	3/3		-	3/3
PE/ECE/13-P to PE/ECE/16-P	Program Elective Course Lab-IV	-	-	2/1	2/1
EEC/ECE/6-P	Major Project	-	-	20/10	20/10
Total		6/6	-	22/11	28/17

Program Elective Course-IV, Program Elective Course-IV Lab, Program Elective Course-V has to be chosen by students from the list offered by ECE Department.

* 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.

Program elective course-IV (Sem8)

Sr. No.	Code	Subject
1.	PE/ECE/13-T	Power Electronics
2.	PE/ECE/14-T	Python Programming
3.	PE/ECE/15-T	Digital Image Processing
4.	PE/ECE/16-T	Antenna and Wave Propagation
5.	PE/ECE/13-P lab	Power Electronics Lab
6.	PE/ECE/14-P lab	Python Programming Lab
7.	PE/ECE/15-P lab	Digital Image Processing Lab
8.	PE/ECE/16-P lab	Antenna and Wave Propagation Lab

Program Elective Course-V (Sem8)

Sr.No.	Code	Subject
1.	PE/ECE/17-T	Introduction to Matlab and Simulink
2.	PE/ECE/18-T	AI & Machine Learning
3.	PE/ECE/19-T	Information Theory and Coding
4.	PE/ECE/20-T	Satellite Communication

Policy Document for providing exemptions in attendance to the B.Tech. students of the University for undertaking various internships/trainings during their final/penultimate semester

1. Background:

It has been realized that the students pursuing B. Tech. programmes offered by the University/affiliated Institutes/Colleges are facing challenges as under:

1. Students selected in industry during their programme are asked to join the industry for internship/training of duration up to one semester.
2. The provision is not there in these programmes to allow the students to join the internship by way of getting the required attendance of semester from internship/training.
3. So, students are not able to join such internship/training consequential to two-fold loss:
   (a) Job opportunity.
   (b) Skill development in industry environment.

But, presently, in the B. Tech. Programmes run by the University, there is no provision for the students to join the industry for such internship/training of/for more than 6–8-week duration. To facilitate the students for joining longer duration internships/trainings, a need for framing a policy document was felt.

Keeping in view the above challenges/statutory position and to avoid hardship to students and to improve the employability of the students, Ch. Devi Lal University, Sirsa has framed a policy to accord exemptions in attendance to students undertaking various internships/trainings during their final/penultimate semester of the B. Tech. Programmes.

2. Applicability of the policy with following Provisions:

The policy is applicable to the students studying in the final semester/ penultimate semester of B. Tech. programmes.

2.1 Provisions:

Student covered as per section title 'Applicability of the Policy' will be governed by the following provisions:

1. The student will be allowed to join the organization for internship/training in the final semester/ penultimate semester of the course for a period of up to one semester only if he/she must be passed/ cleared in all courses/subjects in all the semester examination whose results have been declared.
2. The student will earn his attendance from the organization during the period of internship.
3. Attendance will be certified by the organization, failing which student will be debarred from appearing in the University examinations of that semester.
4. The student will have to give an undertaking that he/she will appear in all the internal/external examination/practical as per requirements of the Programme and as per Schedule of the University examination for that programme. For this he/she will have to

do the necessary preparation by himself/herself and Institute/department will not be responsible for the same.

5. If the student is selected in a company/industry/organization etc., and is asked to join the organization in the final semester/ penultimate semester for a period of upto one semester; then formally constituted Internship Facilitation Committee (IFC) will examine and give its recommendation as deemed fit.

2.2 Composition of Internship Facilitation Committee (IFC):

The composition of IFC will be as under:

1. Dean, Faculty of Engg. & Tech./Director/ Principal (or Nominee) (Chairperson)
2. Chairperson/Head/ In-charge of the concerned Department/Branch (Member)
3. In-Charge Academic Branch/Academic In-charge of Institute (Member)
4. Senior most faculty of the department other than Chairperson/ Director/Head of the Department/Branch (Member)
5. Training and Placement officer/ In-Charge TPO of the Institute /College/Department (Member Secretary)

Any offer by the organisations providing internship on demanding charges from a student will be discouraged by the Internship Facilitation Committee (IFC). Member Secretary of the IFC will schedule the meeting and maintain all the records.

3. Conclusion:

The students can only be allowed to join the internship/training in company/ industry/ organization etc. with exemptions in attendance on the final recommendation of Internship Facilitation Committee (IFC) of the Institute / Department and permission given by the Department/Institute/College authority.

Detailed Syllabus of
B.Tech.(ECE)
III Semester

Mathematics-III

BSC/7-T

General Course Information

Course code: BSC/7-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Mathematics I and Mathematics II

About the Course

This is an advanced mathematics course that offers the knowledge of Fourier Series, Fourier Transforms, Functions of Complex Variables. These concepts are essential for students to solve problems in image processing, digital signal processing and other related engineering fields.

Course Outcomes: By the end of the course students will be able to:

CO1. **Define** concepts and terminology of Fourier Series and Fourier transforms, Functions of complex variables and Power Series etc. (LOTS: Level 1: Remember)
CO2. **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)
CO3. **Apply** principles of functions of complex variables to solve computational problems. (LOTS: Level 3: Apply)
CO4. **Compare** various concepts related to Fourier transforms and functions of complex variables. (HOTS: Level 4: Analyse)
CO5. **Select** suitablemethod for given computational engineering problems and related domain. (HOTS: Level 4: Evaluate)
CO6. **Integrate** the knowledge of Fourier Series and Fourier transforms, Functions of complex variables, and Power Series for solving real world problems. (HOTS: Level 6: Create)

Course Content

Unit I

Fourier Series and Fourier Transforms: Euler's formulae, conditions for a Fourier expansion, change of interval, Fourier expansion of odd and even functions, Fourier expansion of square wave, rectangular wave, saw-toothed wave, half and full rectified wave, half range sine and cosine series.

Unit II

Fourier integrals, Fourier transforms, Shifting theorem (both on time and frequency axes), Fourier transforms of derivatives, Fourier transforms of integrals, Convolution theorem, Fourier transform of Dirac delta function.

Linear Programming Problem (LPP): Introduction; Formulation of linear programming problem (LPP); Graphical method for its solution; Standard form of LPP; Basic feasible solutions; Simplex Method and Dual Simplex Method for solving LPP.

Unit III

Functions of Complex Variable: Definition, Exponential function, Trigonometric and Hyperbolic functions, Logarithmic functions. Limit and Continuity of a function, Differentiability and Analyticity. Cauchy-Riemann equations, necessary and sufficient conditions for a function to be analytic, polar form of the Cauchy-Riemann equations. Harmonic functions.

Unit IV

Complex integral, Cauchy Gaursat theorem (without proof), Cauchy integral formula (without proof), Power series, radius and circle of convergence, Taylor's Maclaurin's and Laurent's series. Zeroes and singularities of complex functions, Residues. Evaluation of real integrals using residues (around unit and semi-circle only).

Text and Reference Books:

1. F. Kreyszig, *Advanced Engineering Mathematics*, 10th edition, Wiley, 2015.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44th edition, 1965.
3. R. K. Jain, S.R.K. Iyenger. *Advance Engineering. Mathematics*, 4th edition, Narosa Publishing House, 2012.
4. Michael D. Greenberg, *Advanced Engineering Mathematics*, 2nd edition, Pearson Education, 2002.
5. Johnson and Miller *Probability and statistics for Engineers*, 8th edition, Pearson Education India, 2015.

CO-PO Articulation matrix: Mathematics-III(BSC/7-T)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:Define concepts and terminology of Fourier Series and Fourier transforms, Functions of complex variables and Power Series etc. (LOTS: Level 1: Remember)	1	-		-	-	-	-	-	-	-	-	0	2	2	2
CO2: **Solve** problems using Fourier transforms in domains like digital electronics and image processing. (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO3:**Apply** principles of functions of complex variables to solve computational problems. (LOTS: Level 3: Apply)	2	2	2	2	-	-	-	-	-	-	-	-	3	2	2
CO4:**Compare** various concepts related to Fourier transforms and functions of complex variables. (HOTS: Level 4: Analyse)	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO5:**Select** suitable method for given computational engineering problems and related domain. (HOTS: Level 4: Evaluate)	3	3	2	3	-	-	-	-	-	-	-	-	3	2	3
CO6: **Integrate**the knowledge of Fourier Series and Fourier transforms, Functions of complex variables, and Power Series for solving real world problems. (HOTS: Level 6: Create)	3	3	2	3	-	-	-	-	-	-	-	-	2	2	3
Level of attainment															

Correlation level: 1- slight /Low **2-** Moderate/ Medium **3-** Substantial/High

DIGITAL ELECTRONICS
PC/ECE/1-T

General Course Information

Course code: PC/ECE/1-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Basics of Electronics

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT Level
CO1	Outline the general concepts and terminology related to logic gates, number systems, logic families, combinatorial and sequential logic circuits.	LOTS: Ll (Remember)
CO2	Discuss the basic analog/digital components and their interconnections in logic families, combinatorial and sequential circuits.	LOTS: L2 (Understand)
CO3	Apply different methods/techniques to design various digital circuits.	LOTS: L3 A I
CO4	Analyse day to day problems and industrial problems for their solutions using digital circuits.	HOTS: L4 (Analyse)
CO5	Contrast different types of digital circuits and their designing methods.	HOTS L5 Evaluate
CO6	Design digital circuit for various Practical problems.	HOTS: L6 Create

Course Content

UNIT-I

Digital signals & logic gates: AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR, Boolean algebra. Review of Number systems. Binary codes: BCD, Excess-3, Gray, EBCDIC, ASCII, Binary arithmetic, Error detection and correction codes. Karnaugh map and Quine Mcluskey methods of simplification

Digital Logic Families: Switching mode operation of p-n junction, bipolar and MOS devices. Bipolar logic families: RTL, DTL, DCTL, HTL, TTL, ECL, MOS, and CMOS logic families. Tristate logic

UNIT-II

Combinational Circuit Design: Circuit design using gates, adder, subtractor, comparator, BCD to seven segment, code converters etc.

Design Using MSI Devices: Multiplexers and Demultiplexers and their use as logic elements, Decoders, Encoders, Adders / Subtractors, BCD arithmetic circuits.

UNIT-III

Flip Flops: S-R, J-K, T, D, master-slave, edge triggered, flip flop conversions Shift registers, bidirectional shift register, sequence generators, Ring counters and Johnson Counter, Design of Asynchronous and Synchronous Counters

Finite State Machines: Timing diagrams (synchronous FSMs), Moore versus Mealy, FSM design procedure, State diagram, State-transition table, State minimisation, State encoding, Next-state logic minimisation, Implement the design

UNIT IV

A/D and D/A Convertors: Weighted resistor and R -2 R ladder D/A Converters, specifications for D/A converters. A/D converters: Quantisation, parallel -comparator, successive approximation, counting type, dualslope ADC, specifications of ADCs.

PLDs: ROM, PLA, PAL, FPGA and CPLDs, Implementation of combinational circuits using ROM, PLA and PAL

TEXT BOOK:

l. Modem Digital Electronics (Edition Ill): R. P. Jain; TMH

2. Digital Integrated Electronics: Taub & Schilling; MGH

REFERENCE BOOKS:

1. Digital Principles and Applications: Malvino& Leach; McGraw Hill.
2. Digital Design: Morris Mano; PHI.

CO-PO Articulation matrix: Digital Electronics (PC/ECE/1-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 logic gates, number systems, logic families, combinatorial and sequential logic circuits.LOTS: Ll (Remember)	2	2	2	2	2	-	-	-	1	-	-	2	3	3	3
CO2:Discuss the basic analog/digital components and their interconnections in logic families, combinatorial and sequential circuits.LOTS: L2 (Understand)	2	2	2	2	2	-	-	-	1	-	-	2	3	3	3
CO3:Applydifferent methods/techniques to design various digital circuits.LOTS: L3 A I	2	2	2	2	2	1	-	-	1	-	-	2	3	3	3
CO4:Analyse day to day problems and industrial problems for their solutions using digital circuits. HOTS: L4 (Analyse)	2	2	2	2	2	1	-	-	1	-	2	3	3	3	3
CO5:Contrast different types of digital circuits and their designing methods.HOTS L5 Evaluate	3	3	3	3	2	1	-	-	1	-	2	3	3	3	3
CO6Design digital circuit for various Practical problems.HOTS: L6 Create	3	3	3	3	2	1	-	-	-	-	2	3	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ANALOG ELECTRONICS-I
PC/ECE/2-T

General Course Information

Course code: PC/ECE/2-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Physics

Course Outcomes

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 the construction & characteristics of the semiconductor, diodes, BJT and BJT amplifiers.	LOTS: LI (Remember)
CO2	Understand & explain various models, methods/techniques for analysis and synthesis of analog circuits.	LOTS: L2 (Understand)
CO3	Apply various models, methods/techniques to solve and synthesize related Analog Circuits.	LOTS: L3 (Apply)
CO4	Analyse & evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desired parameters.	HOTS: L4 & L5 (Analyze&Evaluate)
CO5	Design basic analog circuits for a given/desirable set of circuit/device parameters.	HOTS: L6 (Create)

Course Contents

UNIT-I

Semiconductors: Intrinsic Semiconductors, Doped Semiconductors, Current Flow in Semiconductors, PN Junction structure and operation with open circuit Terminals, The PN Junction with an Applied Voltage, Capacitive Effects in the PN Junction

Diodes: Terminal Characteristics of junction diodes, Zener diode, Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier, Rectifier with a filter capacitor, Limiter circuits, Clamping circuits, voltage doubler.

UNIT-II

BJT: Device Structure and Physical Operation, Current-Voltage Characteristics, Early Effect, BJT as an Amplifier, Effect of Bias Point location on Allowable Signal swing, BJT operation as a switch, BJT circuits atDC

BJT Biasing: Load Line, Operating Point, Voltage divider Bias, Collector to base bias, Biasing using Constant current source

UNIT -III

BJT Small-Signal Operation and Models: The Collector Current and the Transconductance, The Base Current and the Input Resistance at the Base, The Emitter Current and the Input Resistance at the Emitter, Voltage Gain, Separating the Signal and the DC Quantities, The Hybrid-n Model, The T Model, Application of the Small-Signal Equivalent Circuits, Small-Signal Models with Early Effect.

BJT Amplifiers Configurations: Common Base amplifier, Common Emitter Amplifier, Common Emitter Amplifier with Emitter Resistance, Common Collector Amplifier or Emitter Follower, Comparisons

UNIT-IV

Frequency Response of Common Emitter Amplifier: The Three Frequency Bands, High-Frequency Response, Low-Frequency Response, Transistor breakdown and temperature effects.

Regulated Power Supplies: General Filter Considerations, Capacitor Filter, RC Filter, Series voltage regulators, shunt voltage regulators, IC voltage regulator

TEXT BOOKS:

1. Microelectronics Circuits, theory and applications: Sedra& Smith; OXFORD
2. Electronic Devices & Circuits: Boylestad&Nashelsky; Pearson
3. Electronic devices and Circuits (4e): Millman, Halkias and Jit; McGraw Hill

REFERENCE BOOKS:

1. Electronic circuit analysis and design (Second edition): D.A.Neamen; TN'IH.
2. Electronics Principles: Malvino; McGrawHiII
3. Electronics Circuits: Donald L. Schilling & Charles Belove; McGrawHill

CO-PO Articulation matrix: Analog Electronics-I(PC/ECE/2-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 the construction & characteristics of the semiconductor, diodes, BJT and BJT amplifiers.LOTS: LI(Remember)	2	2	2	1	1	-	-	-	1	-	-	-	2	2	2
CO2: Understand & explain various models, methods/techniques for analysis and synthesis of analog circuits.LOTS: L2 (Understand)	2	3	3	1	1	-	-	-	1	-	-	-	2	2	2
CO3: Apply various models, methods/techniques to solve and synthesize related Analog Circuits. LOTS: L3 (Apply)	2	3	3	2	1	1	-	-	1	-	-	2	2	2	2
CO4:Analyse& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desired parameters.HOTS: L4 & L5(Analyze&Evaluate)	3	3	3	2	1	1	-	-	1	-	-	2	3	3	3
CO5:Design basic analog circuits for a given/desirable set of circuit/device parameters. HOTS: L6 (Create)	3	3	3	3	2	2	-	-	1	-	-	3	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

NETWORK ANALYSIS & SYNTHESIS
PC/ECE/3-T

General Course Information

Course code: PC/ECE/3-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Mathematics, Physics, Electrical Technology

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 electric networks, their representation and synthesis.	LOTS: Ll (Remember)
CO2	Understand & explain various theorems and methods/techniques for analysis and synthesis of electric networks.	LOTS: L2 (Understand)
CO3	Apply Laplace transform, transient response approach, network functions/parameters and graphical approach to solve and synthesize various electric networks.	LOTS: L3 (Apply)
CO4	Analyze& evaluate the electric networks, including filters in terms of their realizability, time and frequency domain behavior and stability.	HOTS: L4 & L5 (Analyze&Evaluate)
CO5	Design basic electric networks for a given / desirable set of network parameters.	HOTS: L6 (Create)

Course Contents

UNIT-I

LAPLACE TRANSFORM: Introduction to Laplace transform & its properties, Laplace transform of special signal waveforms, Inverse Laplace transform, Use of Laplace Transform in solving electrical networks.

TRANSIENT RESPONSE: Initial Conditions of resistive, inductive & capacitive Elements, Time- domain analysis of simple linear circuits: Transient & Steady-state Response of RC, RL, RLC Circuits to various excitation signals such as step, ramp, impulse and sinusoidal excitations using Laplace transform.

UNIT-II

NETWORK FUNCTIONS: Terminal pairs or Ports, Network functions for one-port and two-port networks, poles and zeros of Network functions, Restrictions on pole and zero locations for driving point functions and transfer functions, Time domain behaviour from the pole-zero plot.

PARAMETERS OF TWO PORT NETWORKS: Relationship of two-port variables, short-circuit Admi parameters, open circuit impedance parameters, Transmission parameters, hybrid parameters, relationships between parameter sets, Inter-connection of two- port networks.

UNIT-III

NETWORK SYNTHESIS: Concept & significance of Positive real functions, concept of network synthesis, driving point immittance function and structure of LC network, LC network synthesis using Foster and Cauer form, driving point immittance function and structure of RC & RL network, RC & RL network synthesis by Foster and Cauer form.

UNIT-IV

NETWORK GRAPH THEORY: Concept of network graph, Terminology used in network graph, relation between Twigs and Links, properties oftree in a graph, formation of incidence Matrix, number of trees in a graph,

Graph matrices: cut-set matrix, tie set matrix, formulation of network equilibrium equations, network analysis using graph theory.
FILTERS: Introduction to filters, Characteristics of filters, Filter Classification, Passive Filters: Analysis & Design of prototype HPF, LPF, BPF, & BSE, introduction to m-derived filters, Active Filters: Introduction of active filters.

TEXT BOOKS:

1. Circuit Theory: A Chakrabarty; Dhanpat Rai Publication.
2. Network Analysis: Van Valkenburg; Pearson Education.
3. Engineering Network Analysis & Filter Design: G.G Bhise, P.R Chadha, D.C Kulshreshtha; Umesh Publication.

REFERENCE BOOKS:

1. Engineering Circuit Analysis: W H Hayt, Kemmerly, Durbin; McGraw Hill Publication
2. Network Analysis & Synthesis: S.P Ghosh; McGraw Hill.
3. Network Analysis & Synthesis: K.M. Soni; S.K Kataria& Sons Publication.
4. Network Analysis & Synthesis: F.F. Kuo; John Wiley & Sons Inc.

CO-PO Articulation matrix: Network Analysis &Synthesis (PC/ECE/3-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 electric networks, their representation and synthesis.LOTS: Ll (Remember)	1	1	1	1	-	-	-	-	1	-	-	1	2	2	2
CO2: Understand & explain various theorems and methods/techniques for analysis and synthesis of electric networks.LOTS: L2 (Understand)	1	1	1	1	-	-	-	-	1	-	-	1	2	2	2
CO3:Apply Laplace transform, transient response approach, network functions/parameters and graphical approach to solve and synthesize various electric networks. LOTS: L3 (Apply)	2	2	2	2	1	-	-	-	1	-	-	2	2	2	2
CO4:Analyze& evaluate the electric networks, including filters in terms of their realizability, time and frequency domain behavior and stability. HOTS: L4 & L5(Analyze&Evaluate)	3	3	3	3	1	-	2	-	1	-	-	3	3	3	3
CO5: Design basic electric networks for a given / desirable set of network parameters.HOTS: L6 (Create)	3	3	3	3	2	-	2	-	2	-	-	3	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ANALOG COMMUNICATION
PC/ECE/4-T

General Course Information

Course code: PC/ECE/4-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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.

Sr. No.	Course Outcomes At the end of the semester students will be able to:	RBT Level
C01	Outline & recall the terminology, general principles and application areas of analog and digital communication.	LOTS: Ll (Remember)
C02	Understand & interpret the working of communication systems with the help of mathematical expressions, block diagrams and circuit diagrams.	LOTS: L2 (Understand)
C03	Apply the knowledge gained to predict the behaviour of communication systems in the presence of distortion and noise.	LOTS: L3 (Apply)
C04	Analyze& evaluate the performance of various communication systems.	HOTS: L4 & L5 Analyze&Evaluate

Course Contents

UNIT-I

AMPLITUDE MODULATION: Elements of Communication system, Concept of Modulation, Theory of Amplitude Modulation, various forms of AM: DSB-SC, SSB, VSB and their generation, AM Envelope Detector, concept of Coherent Detection, Super-heterodyne receiver.

UNIT-II

ANGLE MODULATION: Theory of FM and PM, Frequency spectrum of FM wave, Relation between M and PM, Narrow Band and Wideband FM, Generation of FM using Direct and Indirect method FM Demodulators: Slope detector, Balanced Slope Detector, Foster-Seeley Discriminator, Ratio Detector, PLL demodulator, Noise and FM, Pre-emphasis and De-emphasis, Comparison of AM, FM and PM.

UNIT -III

PULSE MODULATION: Sampling Process, PAM, PWM, PPM, Quantization, PCM, DPCM, Delta modulation, Quantization noise in PCM System, Companding.

UNIT-IV

NOISE ANALYSIS: External Noise, Internal Noise, White Noise, Noise Figure, Noise Temperature, Narrow Band Noise and its representation in terms of In-phase and Quadrature Components, Noise in AM and FM receivers.

TEXT BOOKS:

1. Electronic Communication Systems, George Kennedy, Bernard Davis & SRM Prasanna, McGraw Hill.
2. Radio Engineering, G. K. Mithal

REFERENCE BOOKS:

1.Communication Systems, Simon Haykin, John Wiley & Sons.
2. Principles of Communication, Taub & Schilling, McGraw Hill.

CO-PO Articulation matrix: ANALOG COMMUNICATION(PC/ECE/4-T)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01: Outline & recall the terminology, general principles and application areas of analog and digital communication.LOTS: Ll (Remember)	3	1	1	1	1	1	-	-	-	-	-	1	3	1	1
C02: Understand & interpret the working of communication systems with the help of mathematical expressions, block diagrams and circuit diagrams.LOTS: L2 (Understand)	3	2	2	1	1	1	-	-	-	-	-	1	3	1	1
C03:Apply the knowledge gained to predict the behaviour of communication systems in the presence of distortion and noise. LOTS: L3 (Apply)	3	3	2	2	1	1	1	-	-	-	-	2	3	3	3
C04: Analyze& evaluate the performance of various communication systems. HOTS: L4 & L5Analyze&Evaluate	3	3	3	2	1	1	1	-	-	-	-	2	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

DIGITAL ELECTRONICS LAB
PC/ECE/1-P

General Course Information

Course code: PC/ECE/1-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 Il 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 tothe 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/HOD along with the internal assessment marks.

Pre-requisites: Basic Electronics

Sr. No.	Course outcomes At the end of the course, students will be able to:	RBT Level
CO1	Perform Experimental work and acquire sound technical knowledge to solve field problems of Digital Electronics.	HOTS: L4 (Analyse)
CO2	Evaluate and analyse truth tables/function tables, characteristics and performance of the given digital components.	HOTS: L5 (Evaluate)
CO3	Design and of combinational and sequential circuits.	HOTS: L6 Create
CO4	Create reports based on experiments performed with effective demonstration and analysis of results.	HOTS: L6 (Create)
CO5	Inculcate ethical practices while performing experiments individually and in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. Study of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR. Realisation ofbasic gates using Universal logic gates.
2. Design & realise a given function using K-maps and verify its performance.
3. Design and realise adder and subtractor circuits.
4. Design and realise comparator and parity generator circuits.
5. Design and realise 3-bit binary to gray code converter.
6. Implementation of multiplexer/encoder using logic gates.
7. Implementation and verification of Decoder/De-muItipIexer
8. To verify the truth tables of S-R, J-K, T & D type flip flops.
9. Design a 4-bit shift-register and verify its operation.
10. To verify the operation of 4-bit synchronous and 4-bit asynchronous counters.
11. Design, and verify the 4-bit ring counter and twisted ring counter.
12. Mini Project. Implementation of any digital circuit on multipurpose board.

Note: At least eight experiments are to be performed in the semester, out of which atleast six experiments should be performed from the given list. The remaining two experiments may either be performed from the list or designed & setup by the 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: Digital Electronics Lab (PC/ECE/1-P)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Perform Experimental work and acquire sound technical knowledge to solve field problems of Digital Electronics.HOTS: L4 (Analyse)	2	2	2	2	2	-	1	-	3	-	-	2	2	2	2
CO2: Evaluate and analyse truth tables/function tables, characteristics and performance of the given digital components.HOTS: L5 (Evaluate)	3	3	3	3	3	-	1	-	-	-	-	3	3	3	3
CO3:Design and of combinational and sequential circuits.HOTS: L6 Create	3	3	3	3	3	-	1	-	-	-	2	3	3	3	3
CO4:Create reports based on experiments performed with effective demonstration and analysis of results.HOTS: L6 (Create)	-	-	-	-	-	2	1	3	3	3	3	-	-	-	-
CO5:Inculcate ethical practices while performing experiments individually and in groups.LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	-	-	-	-
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

ANALOG ELECTRONICS-I LAB
PC/ECE/2-P

General Course Information

Course code: PC/ECE/2-P Course Credits: 2 Contact Hours: 4/week (L-T-P: 0-0-4) Mode: Lab Work	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 Il) 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 Il 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 tothe respective departments in addition to the submitting and uploading ofoverall marks on the university portal as per the requirement of the result branch. The laboratory coursecoordinator 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/HOD along with the internal assessment marks.

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT Level
CO1	Examine the characteristics of devices/circuits.	LOTS: L3 A I
CO2	Analyse & evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-l characteristics and other desirable parameters.	HOTS: L4 & L5 (Analyse &Evaluate)
CO3	Design analog circuits for a given/desirable)set of circuit/device parameters.	HOTS: L6 (Create)
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 individualiy or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To study and verify V-I characteristics of P N junction diode.
2. To study and verify V-I characteristics of Zener diode.
3. To study and verify the characteristics of half wave rectifier with filter circuit.
4. To study and verify the characteristics of full wave rectifiers with filter circuit.
5. To design clipper circuit and observe their output waveforms.
6. To design the clamper circuit and observe their output waveforms.
7. To design the voltage doubler circuit.
8. To study and verify the characteristics of Common Base configurations of a transistor.
9. To study and verify the characteristics of Common Emitter configurations of a transistor.
10. To study and verify the characteristics of Common Collector configurations of a transistor.
11. Design series Voltage regulator circuit.
12. Design shunt Voltage regulator circuit.
13. To study IC voltage regulator.
14. To design a constant current source circuit using BJT.
15. 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. 15) in the group of two-three students before the semester ends.

CO-PO Articulation matrix: Analog Electronics-I Lab (PC/ECE/2-P)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:Examine the characteristics of devices/circuits.LOTS: L3 A I	3	2	2	-	1	1	-	1	2	-	-	1	3	3	3
CO2:Analyse& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-l characteristics and other desirable parameters. HOTS: L4 & L5(Analyse &Evaluate)	3	2	2	-	1	1	-	1	2	-	-	1	3	3	3
CO3:Designanalog circuits for a given/desirable)set of circuit/device parameters.HOTS: L6 (Create)	3	3	3	1	2	2	1	2	3	-	3	2	3	3	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	-	-	-
CO5: Demonstrate ethical practices while performing lab experiments individuality or in groups. LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	3	-	-	-
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

NETWORK ANALYSIS & SYNTHESIS LAB
PC/ECE/3-P

General Course Information

Course code: PC/ECE/3-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 tothe 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/HOD along with the internal assessment marks.

Pre-requisites: Electrical Technology

S. No.	Course Outcomes: At the end of the semester students will be able to:	RBT Level
CO1	Apply theoretical concepts related to electric circuits and two port network parameters on hardware.	LOTS: L3 (Apply)
CO2	Analyze and evaluate the transient response, frequency response and two port network representations in practical manner.	HOTS: L4 & L5 Analyze&Evaluate
CO3	Integrate knowledge of electric circuits like One port networks and filters and design basic circuits for given seofnetworkparameters.	HOTS: L6 (Create)
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. To study the step response of series RC circuit.
2. To study the step response of series RL circuit.
3. To study of phenomenon of resonance in RLC series circuit.
4. To calculate and verify 'Z' parameters of a two-port network.
5. To calculate and verify "Y" parameters of a two-port network.
6. To calculate and verify "ABCD" parameters of a two-port network.
7. To calculate and verify "H" parameters of a two-port network.
8. To determine equivalent parameter of parallel connections of two port network.
9. To plot the frequency responses of low pass filter (LPF) and determine half-power frequency.
10. To plot the frequency responses of high pass filter (HPF) and determine the half- power frequency.
11. To plot the frequency responses of band-pass filters (BPF) and determine the band- width.
12. To synthesise a network of a given network function and verify its response.

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

CO-PO Articulation matrix: Network Analysis and Synthesis Lab (PC/ECE/3-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 electric circuits and two port network parameters on hardware. LOTS: L3 (Apply)	2	2	2	-	1	1	1	-	-	-	1	1	2	2	2
CO2:Analyze and evaluate the transient response, frequency response and two port network representation in practical manner.HOTS: L4 & L5 Analyze&Evaluate	3	3	3	2	1	1	1	-	-	-	1	1	3	3	3
CO3:Integrate knowledge of electric circuits like One port networks and filters and design basic circuits for given set of network parameters. HOTS: L6 (Create)	3	3	3	2	1	1	1	-	-	-	1	2	3	3	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	-	-	-
CO5: Demonstrate ethical practices while performing lab experiments individually or in groups. LOTS: L3 (Apply)	-	-	-	-	-	2	1	3	3	3	3	3	-	-	-
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

INDIAN CONSITUTION

General Course Information:

Course Code: **MC/3-T** Course Credits: 0.0 Mode: Lecture (L) Type: Program Core 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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.

Course Content: Basic features and fundamental principles

1. Meaning of the Constitution law and Constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the fundamental duties and its legal status.
6. The directive principles of state policy- its importance and implementation.
7. Federal structure and distribution of legislative and financial power between the Union and the States.
8. Parliamentary form of government in India- the constitution power and status of the President of India.
9. Amendment of the constitutional powers and procedure.
10. The historical prospective of the constitutional amendments in India.
11. Emergency provisions: national emergency, President rule, financial emergency.
12. Local self-government: constitutional scheme in India.
13. Scheme of the fundamental rights of equality.
14. Scheme of the fundamental rights to certain freedom under Article 19.
15. Scope of the right to Life and personal liberty under Article 21.

Text and Reference Books:

1. M, Laxmikanth, Indian Polity for Civil Services Examination, 5th edition, McGraw Hill Education (India) Private Limited, 2017.

Detailed Syllabus of

B.Tech(ECE)

IV Semester

SENSORS AND MEASURING INSTRUMENTS
PC/ECE/5-T

General Course Information

Course code: PC/ECE/5-T Course Credits: 3 Mode: Lectures (L) Teaching schedule L TP: 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Analog and Digital Electronics

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
C01	Define and describe the terminologies and fundamental principles related to measuring instruments, signal conditioners, sensors and transducers.	LOTS: Ll (Remember)
C02	Understand and explain the operation of different sensors, transducers, signal conditioners and measurement tools.	LOTS: L2 (Understand)
C03	Apply the working principles of the measuring instruments, sensors, transducers and signal conditioning elements for some application design.	LOTS: L3 (Apply)
C04	Analyze and evaluate the instruments, sensors, transducers and signal conditioning elements required for any application design.	HOTS L4 & L5 (Analyze and Evaluate)

Course Contents

UNIT-I

Introduction: Introduction to Measurement, Classification of measurement errors, Static characteristic of Instrument: Accuracy, Precision, Resolution, Sensitivity, Range, Span, Significant Figures, Digital measurement instruments: Multimeter, Frequency Meter, Capacitance Meter, Phase Meter, Tachometer, pH meter, Q meter, General Microprocessor-based impedance measuring instrument, IEEE 488 Bus.

UNIT -II

Signal Generators and Analyzers: Signal generators, Audio generators, Function generators, Pulse generators, R.F Signal generators, Random noise generator, Sweep frequency generators, Frequency synthesizer, Basic wave analyzer, Frequency selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion analyzer Spectrum analyzer, Digital Storage Oscilloscope (DSO).

UNIT -III

Transducers: Introduction, Electrical transducers, Selection criteria of transducers, Resistive transducer, Resistive position transducer, Strain gauge inductive transducer, Differential output transformer, LVDT, Capacitive transducer, load cell, Thermal transducers, thermistor, thermocouple, RTD, Photoelectric transducer, Photoconductive cells (LDR), Photovoltaic cell, transmitter-receiver, Photodiode, Phototransistor, Piezoelectric transducers.

UNIT -IV

Sensors and their applications: Introduction to Automotive Sensors, Sensors for manufacturing, Aerospace sensors, medical diagnostic sensors, Sensors for environmental monitoring, Proximity sensor for robotics and its characteristics.

Signal conditioning: Introduction, Types of signal conditioning, Amplifier, Differential amplifier, Instrumentation amplifier, Filters, A/D conversion, D/A conversion, Signal transmission, LM358 transducer amplifier, LM 386 Audio power amplifier.

TEXT BOOKS:

1. Electronic Instrumentation and Measurements, David A. Bell, Oxford, 3rd Edition.
2. Electronic Instrumentation, H. S. Kalsi, TMH, 2nd Edition.
3. Sensors and Transducers, D. Patranabis, Prentice-Hall, 2nd Edition.
4. Measurement, Instrumentation, and Sensors Handbook, John G. Webster, CRC Press, 1st Edition.

REFERENCE BOOKS:

1. Electronic Instrumentation and Measuring Techniques, W. D. Cooper, PHI.
2. Modern Electronic Instrumentation & Measuring Techniques, Helfrick& Copper, PHI.
3. Measurement Systems, E. O. Doebilin, McGraw Hill.
4. Sensors and signaling conditioning, R. Pallas & J. G. Webster, John Wiley & Sons.

CO-PO Articulation matrix: Sensors and Measuring Instruments (PC/ECE/5-T)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
C01: Define and describe the terminologies and fundamental principles related to measuring instruments, signal conditioners, sensors and transducers.LOTS: Ll (Remember)	2	2	1	1	2	1	-	-	-	-	-	1	2	2	2
C02: Understand and explain the operation of different sensors, transducers, signal conditioners and measurement tools.LOTS: L2 (Understand)	2	2	2	1	2	1	-	-	-	-	-	1	2	2	2
C03: Apply the working principles of the measuring instruments, sensors, transducers and signal conditioning elements for some application design. LOTS: L3 (Apply)	3	2	2	1	2	1	-	-	-	1	-	2	2	2	2
C04: Analyze and evaluate the instruments, sensors, transducers and signal conditioning elements required for any application design. HOTS L4 & L5(Analyze and Evaluate)	3	3	3	1	2	1	-	-	-	1	-	2	2	2	2
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

DIGITAL COMMUNICATION AND INFORMATION THEORY
PC/ECE/6-T

General Course Information

Course code: PC/ECE/6-T Course Credits: 3 Mode: Lectures (L) Teaching schedule L TP : 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Basics of Electronic circuits and introductory concepts of Communication systems.

Sr. No	Course Outcomes At the end of the semester students will be able to:	RBT Level
C01	Recall the terminology, general principles and application areas of digital communication	LOTS: Ll (Remember)
C02	Understand & interpret the working of digital communication systems with the help of mathematical expressions, block diagrams and circuit diagrams.	LOTS: L2 (Understand)
C03	Understand the process of information transmission in digital communication systems and apply different coding schemes to enhance capacity of the system	LOTS: L3 (Apply)
C04	Analyze& evaluate the performance of various error control codes in communication systems.	HOTS: L4 & L5 Analyze&Evaluate

Course Contents

UNIT-I

DIGITAL MODULATION: Pulse Code Modulation,Differential Pulse code Modulation , Adaptive Differential Pulse Code Modulation, Delta Modulation , Adaptive Delta Modulation, Coding of speech signal at low bit rates (Vocoders, LPC).

UNIT-II

DIGITAL TRANSMISSION: Digital Communication system**,** General description of ASK, FSK and PSK. Transmission, Reception and Signal space representation: BPSK, DPSK, QPSK, M-ary PSK, ASK, QASK, BFSK, MSK; Power spectra of digitally modulated signals, Comparison of different digital modulation schemes.

UNIT -III

INFORMATION THEORY FUNDAMENTALS: Uncertainty, Information and Entropy, Source coding Theorem, Huffman coding, Shannon Fano coding, Discrete Memory less channels, channel capacity, channel coding Theorem, Channel capacity Theorem.

UNIT-IV

ERROR CONTROL CODING: Linear Block codes, Syndrome Decoding,Minimum distance consideration, cyclic codes, Generator Polynomial,Parity check polynomial, Encoder for cyclic code, calculation of syndrome, Convolutional codes.

TEXT BOOKS:

1. Electronic Communication Systems, George Kennedy, Bernard Davis & SRM Prasanna, McGraw Hill.
2. Communication Systems, Simon Haykin, John Wiley & Sons.
3. Principles of Communication, Taub & Schilling, McGraw Hill.

REFERENCE BOOKS:

1. Modern Digital & Analog Communication Systems, B.P. Lathi, Oxford University Press.
2. Communication Systems, A. Bruce Carlson, P.B Crilly, J.C Rutledge, McGraw Hill.
3. Digital Communication, John G. Proakis, PHI.

CO-PO Articulation matrix: Digital Communicationand Information theory (PC/ECE/6-T)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:Recall the terminology, general principles and application areas of digital communication	3	1	1	1	1	1	-	-	-	-	-	1	3	1	1
CO2: Understand & interpret the working of digital communication systems with the help of mathematical expressions, block diagrams and circuit diagrams.	3	2	2	1	1	1	-	-	-	-	-	1	3	1	1
CO3:Understand the process of information transmission in digital communication systems and apply different coding schemes to enhance capacity of the system	3	3	2	2	1	1	1	-	-	-	-	2	3	3	3
CO4:Analyze& evaluate the performance of various error control codes in communication systems.	3	3	3	2	1	1	1	-	-	-	-	2	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ANALOG ELECTRONICS-II
PC/ECE/7-T

General Course Information

Course code: PC/ECE/7-T Course Credits: 3 Mode: Lectures (L) Teaching schedule L TP: 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Analog Electronics-I

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 construction & characteristics of MOSFET, amplifiers and oscillators.	LOTS: Ll (Remember)
CO2	Understand & explain various models, methods/techniques for analysis and synthesis of analog circuits.	LOTS: L2 (Understand)
CO3	Apply various models, methods/techniques to solve and synthesize related Analog Circuits.	LOTS: L3 (Apply)
CO4	Analyze& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desirable parameters.	HOTS: L4 & L5: (Analyze& Evaluate)
CO5	Design basic analog circuits networks for a given/desirable set of circuitdevice parameters.	HOTS: L6 (Create)

Course Contents

UNIT-I

MOSFET: Device Structure and Physical Operation, MOS Capacitor, Current—Voltage Characteristics, Body Effect, MOSFET as an Amplifier, MOSFET operation as a switch, MOSFET circuits at DC.

MOSFET Biasing: Biasing by Fixing VGS, Biasing by Fixing VG and connecting a resistance in source, Drain to Gate Feedback resistor bias, Biasing using Constant current source.

UNIT-II

MOSFET Small Signal Operation and Models: DC Bias Point, Signal Current in the Drain Termina . Voltage Gain, Small-Signal Equivalent-Circuit Models, Transconductance gm, T Equivalent-Circuit Model.

MOSFET Amplifiers Configurations: Common Gate amplifier, Common Source Amplifier, Common Source Amplifier with a source Resistance, Common Drain Amplifier.

UNIT -III

Output Stages and Power Amplifiers: Classification of Output Stages-Class A, B, and C operations; Class A . large Signal amplifiers, Second and higher order harmonic distortion, efficiency, transformer coupled power amplifier, Class B amplifier: efficiency & distortion, push-pull amplifiers, Class C amplifier, Class AB operation.

UNIT-IV

Feedback Amplifiers: Classification of amplifiers, Feedback concept, transfer gain with feedback, general characteristics of negative feedback amplifiers, effect of negative feedback on input and output resistance, voltage series feedback, current series feedback, current shunt feedback, voltage shunt feedback.

OSCILLATORS: General form of oscillator circuit, Barkhausen's criteria, R-C phase shift oscillator, Hartley oscillator, Colpitts oscillator, Wien-bridge oscillator, Crystal oscillator.

TEXT BOOKS:

1. Microelectronics Circuits, theory and applications:Sedra& Smith; OXFORD
2. Electronics Devices & Circuits: Boylestad&Nashelsky ; Pearson
3. Electronics devices and Circuits(4e): Millman, Halkias and Jit; McGrawHiII

REFERENCE BOOKS:

1. Electronic circuit analysis and design (Second edition): D.A.Neamen; TMH.
2. Electronics Principles: Malvino; McGrawHill
3. Electronics Circuits: Donald L. Schilling & Charles Belove; McGrawHill

CO-PO Articulation matrix: Analog Electronics-II (PC/ECE/7-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 construction & characteristics of MOSFET, amplifiers and oscillators.LOTS: Ll (Remember)	1	1	2	1	1	-	-	-	-	-	-	1	2	2	2
CO2: Understand & explain various models, methods/techniques for analysis and synthesis of analog circuits.LOTS: L2 (Understand)	1	3	2	1	2	-	-	-	-	-	-	1	3	2	1
CO3: Apply various models, methods/techniques to solve and synthesize related Analog Circuits.LOTS: L3 (Apply)	2	3	2	2	2	-	-	-	-	-	-	1	3	2	2
CO4: Analyze& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desirable parameters. HOTS: L4 & L5: (Analyze& Evaluate)	3	3	3	2	2	-	1	-	-	-	-	3	3	2	3
CO5: Design basic analog circuits networks for a given/desirable set of circuitdevice parameters.HOTS: L6 (Create)	3	3	3	3	2	-	1	-	-	-	-	3	3	2	3
Level of attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ELECTROMAGNETIC THEORY
PC/ECE/8-T

General Course Information

Course code: PC/ECE/8-T Course Credits: 3 Mode: Lectures (L) Teaching schedule L TP : 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Communication Engineering

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	Memorize & define different electromagnetic laws and fundamental principles related to electromagnetic wave propagation, transmission line theory, and waveguides.	LOTS: LI (Remember)
CO2	Derive & explain theorems related to vector algebra, electrostatics, magnetostatics, and electromagnetic wave propagation.	LOTS: L2 (Understand)
CO3	Apply the laws to solve problems related to electrostatics, magnetostatics, electromagnetic wave propagation, vector algebra, transmission lines and waveguides.	LOTS: L3 (Apply)
CO4	Analyze all the laws and theorem and evaluate their utility in solving practical problems.	HOTS: L4 & L5 (Analyze & Evaluate)

Course Contents

UNIT-I

VECTOR ALGEBRA: Cartesian coordinates, cylindrical coordinates, spherical coordinates, Vector calculus: Differential length, area and volume, line, surface and volume integrals and their significance, Del operator, gradient of a scalar, divergence of a vector and divergence theorem, curl of a vector and Stokes's theorem, classification of vector fields.

REVIEW OF ELECTRIC FIELDS: Coulomb's law and electric field intensity, field due to a continuo charge distribution: field of a line charge, field of a sheet of charge, electric flux density, Gauss's law d applications, electric potential, relationship between E and V, electric dipole, energy density in electro fields.

UNIT-II

REVIEW OF MAGNETIC FIELDS: Convection and conduction currents, conductors, dielectric constant, continuity equation, boundary conditions, Poisson's, and Laplace's equations, capacitance, Biot-Savart's Law, Ampere's circuit Law, magnetic flux density, Maxwell's equation for static fields, magnetic scalar and vector

potentials, forces due to magnetic field, magnetic torque, magnetic boundary conditions, inductor, magnetic energy.

UNIT-III

TIME VARYING FIELDS AND MAXWELL'S EQUATIONS: Faraday's law, displacement current, Maxwell's equations in point form and integral form, retarded potentials.

ELECTROMAGNETIC WAVE PROPAGATION: Three-dimensional wave equations, Plane Waves & its Properties, Propagation of Plane Waves in free space, lossy dielectrics, lossless dielectrics, Good Conductors. Power and Poynting Vector.

UNIT-IV

ELECTROMAGNETIC WAVE PROPERTIES: Skin Effect, Wave Polarization, Reflection of Uniform Plane Waves (Normal Incidence).

TRANSMISSION LINES: Transmission line parameters, transmission line equations, input impedance, standing wave ratio. and power, Smith chart.

TEXT BOOKS & REFERENCE BOOKS:

1. Elements of Electromagnetics, Matthew N. O. Sadiku, Oxford University Press, 7th Edition.
2. Electromagnetic Waves and Radiating Systems, E. C. Jordan and K. G. Balmain, PHI, 3 rdEdition.
3. Field and Wave Electromagnetics, David K. Chang, Addison Wesley, 3rd Edition.
4. Engineering Electromagnetics, W. H. Hayt, Tata Mc-Graw, 8th Edition.

CO-PO Articulation matrix: Electromagnetic Theory (PC/ECE/8-T)

List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Memorize & define different electromagnetic laws and fundamental principles related to electromagnetic wave propagation, transmission line theory, and waveguides.LOTS: LI (Remember)	3	1	1	1	1	1	-	-	-	-	-	1	3	1	1
CO2: Derive & explain theorems related to vector algebra, electrostatics, magnetostatics, and electromagnetic wave propagation.LOTS: L2 (Understand)	3	2	2	1	1	1	-	-	-	-	-	1	3	1	1
CO3:Apply the laws to solve problems related to electrostatics, magnetostatics, electromagnetic wave propagation, vector algebra, transmission lines and waveguides. LOTS: L3 (Apply)	3	3	2	2	1	1	1	-	-	-	-	2	3	3	3
CO4: Analyze all the laws and theorem and evaluate their utility in solving practical problems. HOTS: L4 & L5(Analyze&Evaluate)	3	3	3	2	1	1	-	-	-	-	-	2	3	2	3
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

SIGNALS & SYSTEMS
PC/ECE/9-T

General Course Information

Course code: PC/ECE/9-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., 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: Physics, Maths.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	Define & describe terminology and categorization related to signals, systems and transformation techniques.	LOTS:Ll (Remember)
CO2	Understand & explain properties of various signals & systems along with concept of conversion/transformation of signals like analog to digital conversion, time to frequency transformation.	LOTS:L2 (Understand)
CO3	Apply signal properties and transformation techniques on various periodic/aperiodic analog/discrete signal.	LOTS: L3 (Apply)
CO4	Analyse & evaluate LTI system response using transformation techniques.	HOTS: L4 & L5 (Analyze&Evaluate)
CO5	Compare the properties of various signals and systems along with transformation techniques and their convergence region.	HOTS: L5 (Evaluate)

Course Contents

UNIT-I

INTRODUCTION TO SIGNALS: Signal definition, classification of signals, basic/singularity continuous and discrete-time signals, basic operations: time shifting, time reversal, time scaling on signals, signal representation in terms of singular functions, correlation of signals and its properties, representation of a continuous-time signal by its samples: the sampling theorem, reconstruction, aliasing.

UNIT-II

SYSTEM & ITS PROPERTIES: system, classification of systems: linear & nonlinear systems; static & dynamic systems, causal & non-causal system, invertible & non-invertible, stable & unstable system, time variant & time invariant systems with- examples, -linear-time-invariant systems: definition and properties, impulse response, convolution sum and its properties, representation of LTI systems using differential and difference equations.

UNIT-III

FOURIER SERIES & FOURIER TRANSFORM: Introduction to Frequency domain Representation, Fourier Series Representation of Periodic Signals, Properties of Fourier Series, Fourier Transform for periodic and Aperiodic signals, Convergence of Fourier Transform, Properties of Fourier Transform, Applications of Fourier Transform.

DISCRETE-TIME FOURIER TRANSFORM: Fourier Transform representation for Discrete-Time Aperiodic & Periodic Signals, Properties of Discrete-Time Fourier Transform.

UNIT-IV

Z-TRANSFORM: Introduction to Z-Transform, Region of Convergence (ROC) for Z-Transform, Z-Transform Properties, Inverse Z-Transform, Analysis of LTl Systems Using Z-Transform, Application of Z transform, Introduction to Hilbert Transform.

TEXT BOOKS:

l . Oppenheim, A. S. Willsky, with S. Nawab "Signals &Systems",Prentice -Hall India.
2. Tarun K. Rawat, "Signal & Systems", Oxford University Press.
3. Farooq Husain, "Signals & Systems", Umesh Publications.

REFERENCE BOOKS:

l. S. Salivahanan, A. Vallavraj, C. Gnanapriya, "Digital Signal Processing", Tata McGraw Hill.
2. J. G. Proakis, D. G. Manolakis, "Digital Signal Processing, Principles, Algorithms, & Applications", Prentice-Hall India.
3. B. Kumar, "Signals and Systems", New Age International Publishers.

CO-PO Articulation matrix: Signals and Systems(PC/ECE/9-T)

List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1:Define & describe terminology and categorization related to signals, systems and transformation techniques.LOTS:Ll (Remember)	3	3	2	1	1	-	-	-	-	-	-	1	2	2	2
CO2:Understand & explain properties of various signals & systems along with concept of conversion/transformation of signals like analog to digital conversion, time to frequency transformation.LOTS:L2 (Understand)	3	3	2	1	1	-	-	-	-	-	-	1	2	2	2
CO3:Apply signal properties and transformation techniques on various periodic/aperiodic analog/discrete signal.LOTS: L3 (Apply)	3	3	2	1	1	1	-	-	-	-	-	2	2	2	2
CO4:Analyse & evaluate LTI system response using transformation techniques.HOTS: L4 & L4(Analyze&Evaluate)	3	3	3	2	2	2	-	-	-	-	-	2	3	3	3
CO5:Compare the properties of various signals and systems along with transformation techniques and their convergence region.HOTS: L5 (Evaluate)	3	3	2	2	2	2	-	-	-	-	-	2	3	3	3
Level of attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

SENSORS AND MEASURING INSTRUMENTS LAB
PC/ECE/5-P

General Course Information

Course code: PC/ECE/5-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 Il 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 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/HOD along with the internal assessment marks.

Pre-requisites: Analog and Digital Circuits

S. No.	Course Outcomes: At the end of the semester, students will be able to:	RBT Level
CO1	Apply theoretical concepts related to measurement instruments, signalling conditioning elements, transducers on hardware.	LOTS: L3 (Apply)
CO2	Analyze and evaluate the working principles and performance of the devices/instruments used in experiment.	HOTS: L4 & L5 (Analyze&Evaluate)
CO3	Integrate knowledge of signal conditioning elements and transducers to design basic circuits for a given application.	HOTS•. L6 (Create)
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. To familiarize with the control panel and various measurements using DSO and Function Generator.
2. To familiarize with the control panel and various measurements using spectrum analyzer.
3. To study the Lissajous pattern for frequency and phase measurement.
4. To measure values of different components and Q of a coil using LCR-Q meter.
5. To find the least count of a micrometre.
6. To determine the thickness of a given object using LVDT.
7. To measure linear displacement using LVDT.
8. To measure the distance using LDR.
9. To study the working principle of RTD and use it for temperature measurement/
10. To study the characteristics of thermocouple and use it for temperature measurement.
11. To measure the variation of pressure using Strain Gauge.
12. To study the piezo-electric transducer and its characteristics.
13. To measure the angular displacement using Capacitive Pick-up.
14. To measure linear displacement using Inductive Pick-up.
15. To measure speed using photoelectric and magnetic sensor kit.
16. Implementation of 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 of the syllabus.

CO-PO Articulation matrix: Sensors and Measuring Instruments Lab (PC/ECE/5-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 measurement instruments, signalling conditioning elements, transducers on hardware.LOTS: L3 (Apply)	3	1	1	-	1	1	-	-	2	-	-	1	3	2	1
CO2:Analyze and evaluate the working principles and performance of the devices/instruments used in experiment.HOTS: L4 & L5 (Analyze&Evaluate)	2	2	1	-	1	1	-	-	2	-	-	1	3	2	1
CO3: Integrate knowledge of signal conditioning elements and transducers to design basic circuits for a given application.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 attainment															

Correlation level: **1**- Slight /Low **2**- Moderate/ Medium **3**- Substantial/High

ANALOG AND DIGITAL COMMUNICATION LAB
PC/ECE/6-P

General Course Information

Course code: PC/ECE/6-P Course Credit:1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 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 Il) 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 Il 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 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/HOD along with the internal assessment marks.

Pre-requisites: Analog and Digital Circuits

Sr. No.	Course Outcomes: At the end of the lab course a student would be able to:	RBT Level
CO1	Apply theoretical concepts related to analog, digital and pulse modulation/demodulation techniques on hardware.	LOTS: L3 (Apply)
CO2	Analyze and compare the time domain response of various modulation/demodulation techniques in practical manner.	HOTS: L4 (Analyze)
CO3	Evaluate the performance of various modulation/demodulation techniques.	HOTS: L5 (Evaluate)
CO4	Create written records for the given assignments with problem definition, design of solution and conclusions.	HOTS: L6 (Create)
CO5	Demonstrate ethical practices while performing lab experiments individually or in groups.	LOTS: L3 (Apply)

LIST OF EXPERIMENTS

1. To familiarize with the control panel and various measurements using CRO/DSO & Function Generator.
2. To study Amplitude Modulation & Demodulation and determination of Modulation index.
3. To study Frequency Modulation and Demodulation.
4. To study Pulse Amplitude Modulation and Demodulation.
5. To study Pulse Width Modulation and Demodulation.
6. To study Pulse Code Modulation.
7. To study ASK Modulation Technique.
8. To study FSK Modulation Technique.
9. To study BPSK Modulation Technique.
10. To study QPSK Modulation Technique
11. Simple project (Any topic related to the scope of the course).

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six 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: Analog and Digital Communication Lab (PC/ECE/6-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 analog, digital and pulse modulation/demodulation techniques on hardware.LOTS: L3 (Apply)	3	2	2	-	3	1	-	1	2	-	-	1	3	2	2
CO2: Analyze and compare the time domain response of various modulation/demodulation techniques in practical manner.HOTS: L4 (Analyze)	2	2	2	-	3	1	-	1	2	-	-	1	3	2	2
CO3: Evaluate the performance of various modulation/demodulation techniques.HOTS: L5 (Evaluate)	2	2	2	-	3	1	-	1	2	-	-	1	3	2	2
CO4: Create written records for the given assignments with problem definition, design of solution 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 attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

ANALOG ELECTRONICS-II LAB
PC/ECE/7-P

General Course Information

Course code: PC/ECE/7-P Course Credits: 2 Contact Hours: 4/week (L-T-P: 0-0-4) Mode: Lab Work	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 and MLE Il) 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 Il 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 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO1	Examine the characteristics of devices/circuits	LOTS: L3
CO2	Analyze& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desirable parameters.	HOTS: L4 & L5 (Analyze&Evaluate)
CO3	Design basic analog circuits for a given/desirable set of circuit/device parameters.	HOTS: L6 (Create)
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. To study and design Class A power amplifier and determine its efficiency.
2. To study and design Class B power amplifier and determine its efficiency.
3. To study and design Class C power amplifier and determine its efficiency.
4. To Design the RC phase shift oscillator circuit.
5. To Design the Wein bridge oscillator circuit.
6. To Design the Hartley oscillator circuit.
7. To Design the Colpitts oscillator circuit.
8. To study the effect of BJT voltage series feedback amplifier and determine the gain, frequency response, input and output impedance with and without feedback
9. To study the effect of FET voltage series feedback amplifier and determine the gain, frequency response, input and output impedance with and without feedback.
10. To study the V-I characteristics of MOSFET in Common Gate configurations.
11. To study the V-I characteristics of MOSFET in Common Source configurations
12. To study the V-I characteristics of MOSFET in Common Drain configurations .
13. To design a R-C coupled single stage amplifier and determine Gain, Bandwidth, Input impedance and output impedance.
14. To design a BJT Darlington Emitter Follower and determine Gain, Bandwidth, Input impedance and output impedance.
15. 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. 15) in the group of two-three students before the semester ends.

CO-PO Articulation matrix: Analog Electronics-II Lab (PC/ECE/7-P)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Examine the characteristics of devices/circuitsLOTS: L3 A I	3	1	1	-	1	1	-	1	2	-	-	1	3	2	1
CO2: Analyze& evaluate the analog devices and circuits in terms of their gain, bandwidth, efficiency, impedance, V-I characteristics and other desirable parameters. HOTS: L4 & L5(Analyze&Evaluate)	2	2	1	-	1	1	-	1	2	-	-	1	3	2	1
CO3:Design basic analog circuits for a given/desirable set of circuit/device parameters.HOTS: L6 (Create)	2	1	3	1	2	2	1	2	3	-	1	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 attainment															

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3**- Substantial/High

PROBLEM SOLVING USING MATLAB
PC/ECE/10-P

General Course Information

Course code: PC/ECE/10-P Course Credit:1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 MIÆ Il) 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 Il 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 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/HOD along with the internal assessment marks.

Pre-requisites: Basic Programming Skills

Sr.No.	Course Outcomes: At the end of the lab course a student would be able to:	RBT Level
CO1	Study basic commands and apply programming skills to implement solutions to the given assignments usingMATLAB	LOTS:L3 (Apply)
CO2	Analyze and Evaluate the output of various Matrices operation usingMATLAB	HOTS:L4 & L5 (Analyse &Evaluate)
CO3	Devise software solutions for common processes of communications systems	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/ASSIGNMENTS

1. Introduction to MATLAB
2. To study various commands of MATLAB
3. Write a program to perform different matrices operations as addition, subtraction, multiplication, inverse and determinant.
4. Write a program to demonstrate output of various plotting commands.
5. Write a program to plot different signals as impulse, step, ramp, sinusoidal, cosine and exponential.
6. Write a program to find convolution of two sequences.
7. Write a program to find correlation and Auto-correlation between two sequences
8. Write a program to perform Amplitude modulation and Demodulation
9. Write a program to perform Amplitude modulation and Demodulation
10. Write a program for signal sampling and reconstruction.
11. Write a program to perform basic image processing functions
12. Write a program to perform basic control system functions.
13. Design a communication system using SIMULINK

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six 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: Problem solving using MATLAB (PC/ECE/10-P)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Study basic commands and apply programming skills to implement solutions to the given assignments using MATLAB	2	2	2	1	3	1	-	-	-	-	-	-	2	2	2
CO2: Analyze and Evaluate the output of various Matrices operation using MATLAB	2	2	2	3	3	1	-	-	-	-	-	-	2	2	2
CO3: Devise software solutions for common processes of communications systems	3	3	2	3	3	1	-	-	-	-	-	-	2	2	2
CO4: Create written records for the given assignments with problem definition, design of solution and conclusions.	-	-	-	-	-	2	1	3	3	3	3	-	-	-	2
CO5: Demonstrate ethical practices while solving problems individually or in groups.	-	-	-	-	-	2	1	3	3	3	3	-	-	-	2
Level of attainment															

ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

MC/4-T

General Course Information

Course code-MC/4-T Course Credits: 0 Mode: Lectures (L) Teaching schedule L T P: 2 0 0 Examination Duration:03Hours	Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70) Three minor tests, each of 20 marks, will be conducted. 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.

About the Course and its Outcomes:

This course is designed to acquaint the students with Indian Knowledge traditions. It introduces the students to Vedic Period, Post-Vedic period, Sufi and Bhakti Movement in India and social reform movements of 19th Century.

Course outcomes:

Sr.No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Recognize the forms and sources of Indian Traditional Knowledge	L1 (Remembering)
CO 2	Identify the contribution of great ancient Indian Scientists and spiritual leaders to the World of Knowledge	L2 (Understanding)
CO 3	Apply the reasoning based on the objectivity and contextual knowledge to address the social and cultural issues prevalent in the Indian Society.	L3 (Applying)
CO 4	Differentiate the myths, superstitions form the reality in context of traditional knowledge to protect the physical and social environment.	L4(Analyzing)
CO 5	Suggest means of creating just a fair and social environment that is free from any prejudices and intolerance for different opinions and cultures.	L5 (Evaluating)

Course Content

UNIT-I

Introduction to Indian Traditional Knowledge: Definition traditional knowledge, forms, resources and dissemination of traditional knowledge.

Vedic Period: Vedas and Upnishads, Yogsutras of Patanjali.

Post Vedic Period: Budhism, Jainism and Indian Materialism, Charvak Schools of Thoughts.

UNIT-II

Sufi and Bhakti Movement (14th to 17th Century): सगुण-निर्गुण भक्ति, Sufism and Sufi Saints, Kabir, Dadu, Soordas, Tulsidas,Guru Nanak Dev Ji and Guru Jambheshwar Ji Maharaj, composite cultural of Indian sub-continent.

UNIT- III

Jyotirao Phule, Savitri Bai Phule, Arvind, Vivekanand and Other 18th&19th Century Social Reform Movements; India's Cultural Heritage.

UNIT-IV

India's Contribution to the World of Knowledge: प्राचीन भारत के महान विज्ञानिक, बोधायन, चरक, कोमारभरित्य, जीवन, सुश्रुत, आर्यभट्ट, बारहमिहिर, ब्रहमगुप्त, नागार्जुन, वाग्भट्ट, Astrology and Astronomy, Myths and Realities.

TEXT AND REFERENCES BOOKS:

1. A.L. Bansham, The Wonder That was India, A Survey of the culture of the, Indian Sub- Continent before, the Coming of the Muslims, Vol 1, Groove Press, New York,1959.
2. S. A.A Rizvi, Wonder That was India, A survey of the history and culture of the Indian sub-continent from the coming of the Muslims to the British conquest 1200-1700, Vol-II, Rupa and Co.2001.
3. JambhavaniMoolSanjiviniVyakhya
4. प्रतियोगितादर्पणअतिरिक्तांकसीरीज–5 भारतीयकलाएवंसंस्कृति
5. B. V. Subbarayappa,*A Historical Perspective: Science in India:*, Rupa Publications, New Delhi 2013.
6. Bishnoi, K.R. and N.R. Bishnoi (eds). Religion and Environment. Vol. II, New Delhi: ArihantPrakashanPvt. Ltd., 2002.

Course Articulation Matrix:

Course/Course Code: Essence of Indian Traditional Knowledge (MC/4-T)										Semester: IV		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	-	-	-	-	-	-	1
CO2	-	2	1	-	-	-	-	-	-	-	-	1
CO3	-	3	3	2	-	3	-	-	-	-	-	3
CO4	-	2	3	3	-	3	1	-	-	-	-	3
CO5	-	3	3	3	-	3	-	-	-	-	-	3

Correlation level: **1**- Slight /Low **2-** Moderate/ Medium **3-** Substantial/High

HUMAN VALUES AND PERSONALITY DEVELOPMENT

HSMC/2-T

General Course Information

Course Code: HSMC/2-T Course Credits: 0.0 Mode: Lecture (L) and Tutorial (T) Type: Program Core Teaching Schedule L T P: 3 0 0 Examination Duration: **Internal Examination**	**Course Assessment Methods: Total Marks: 100** **(Internal Examination only)** The internal assessment of 30 marks will be on the minor tests, class attendance, assignments, and class performance. 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 assessment of 70 marks will be at the end of Semester through Interview/ VIVA-VOCE only by a committee of Two Faculty Members including course coordinator and a faculty member appointed by Chairperson/Head of concerned Department.

Pre-requisites: None

About the Course: This course is designed to develop a holistic perspective based on self exploration and co-existence in society and nature. The focus is on to understand harmony and being in harmony with the society and the environment around us. The student will nurture a habit of self-reflection and courage to act. This course includes practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking).

Sr.No.	Course Outcomes At the end of the semester, students will be able to:
CO 1	Exhibit awareness about oneself, one's surroundings and goals in one's life.
CO 2	Stay in harmony with society and nature.
CO 3	Develop healthy and harmonious relationships.
CO 4	Understand groups and develop team spirit
CO 5	Manage stress effectively.
CO6	Exhibit leadership qualities.
CO7	Excel in Personal and Professional Life.

Course Content

Unit I

Understanding the concept of self, Exploration of self with JOHARI-Window, Self-Esteem, Characteristics of individuals with low and high self esteem. Self Confidence, strategies of building self-confidence.

Personality: Definition. Types & Traits; Relevance & Importance of nature and nurture 'n the development of personality.

Unit II

Nature of socialization, Socialization process. contribution to society and nation, importance of discipline and handwork, ecological responsibility of engineers, professional Ethics: Competence in Professional values and ethics.Personal and Professional Excellence: Identifying of long-term choices and goals.

Unit III

Meaning and nature of teams, External and internal factors affecting team building. Leadership Meaning, Nature and Functions. leadership styles in organization. meaning and nature of stress, causes, effects and management.

Unit IV

Meaning and importance of human rights, Human rights awareness.Harmony in nature, understanding co-existence, harmony at all levels of existence. Understanding the concept of happiness and well-being. Role and importance of positive emotions: Gratitude, hope and optimism.

Text and Reference Books:

1. Bates, A. P. and Julian, J. : Sociology - Understanding Social Behaviour.
2. Dressler, David and Cans, Donald: The Study of Human Interaction.
3. Pestonjee, D.M, Pareek, Udai, Agarwal Rita; Studies in Stress And its Management
4. Organizational Behaviour, Davis, K.
5. Hoover, Judhith D. Effective Small Group and Team Communication, 2002 Harcourt College Publishers
6. Dick, McCann &Margerison, Charles: Team Management, 1992 Edition, viva books
7. Bates, A. P. and Julian, J.: Sociology - Understanding Social Behaviour
8. Dressier, David and Cans, Donald: The Study of Human Interaction
9. Pestonjee, D.M. Pareek, Udai, Agarwal Rita; Studies in Stress And its Management
10. Pestonjee, D.M.; Stress and Coping: The Indian Experience
11. Clegg, Brian: Instant Stress management Bring calm to your life now.

Detailed Syllabus
of
B.Tech.(ECE)
V Semester

Microprocessors and Microcontrollers
PC/ECE/11-T

General Course Information

Course code: PC/ECE/11-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: The students are expected to have a strong background in Digital Electronics

Sr. No.	Course Outcomes At the end of the semester students will be able to:	RBT Level
CO1	Understand the architecture of 8085 and 8086 Microprocessor.	L1
CO2	Understand the architecture of 8051 Microcontroller	L2
CO3	Summarize the functionality of various peripheral chips.	L3
CO4	Interface & interact with different peripherals and devices.	L4
CO5	compare and contrast the working of 8085 and 8086 microprocessors	L6

Unit-I

Microprocessor 8085 History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; counters and time delays; stack and subroutines; interrupts.

Unit-II

Architecture of 8086, block diagram of 8086, details of sub-blocks such as EU, BIU; memory segmentation and physical address computations, program relocation.

Unit-III

Microcontroller 8051 - Building Blocks Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack.

Unit-IV

The 8255 PPI chip: Architecture, control words, modes and examples. Introduction to DMA process, 8237 DMA controller. 8259 Programmable interrupt controllers.
Parallel and serial ADC & DAC interfacing; LCD interfacing, Keyboard interfacing with 8051 microcontroller.

Text Books:

1. Microprocessor Architecture, Programming & Applications with 8085: Ramesh S Gaonkar; Wiley Eastern Ltd. ,5th edition, 2002.
2. The Intel Microprocessors 8086- Pentium processor: Brey; PHI, 8th edition, 2009
3. Microprocessors and Interfacing Douglas V Hall TMH -2005.
Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996
4. Kenneth Ayala, The 8051 Microcontroller, Cengage Learning

Reference Books:

1.The 8088 & 8086 Microprocessors-Programming, interfacing,Hardware & Applications :Triebel & Singh; PHI , 4th edition , 2003
2. Microcomputer systems: the 8086/8088 Family: architecture, Programming & Design: Yu-Chang Liu & Glenn A Gibson; PHI, 2001.
3. Advanced Microprocessors and Interfacing: Badri Ram; TMH, 2001. 7. The Intel Microprocessors, Barry B. Brey, 8th Edition, PHI,201
4.Subrata Ghoshal, 8051 Microcontroller: Internals, Instructions, Programming and Interfacing, Pearson Education

CO-PO Articulation matrix: Microprocessors and Microcontrollers (PC/ECE/11-T)

List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3
CO2	2	-	-	-	-	-	-	-	-	-	-	-	3	-	3
CO3	2	1	-	-	-	-	-	-	-	-	-	-	3	-	3
CO4	2	1	-	-	-	-	-	-	-	-	-	-	-	1	3
CO5	2	-	1	1	2	-	-	-	-	-	-	1	-	1	3
Level of attainment															

Digital Signal Processing
PC/ECE/12-T

General Course Information

Course code: PC/ECE/12-T Course Credits: 4 Mode: Lectures (L) Teaching schedule L T P: 3 1 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: signals and systems

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand the concept and advantages of digital signal processing.	L1
CO 2	To summarize differences between time domain and frequency domain analysis tools.	L2
CO 3	To apply DFT and FFT tools to determine the spectral components of a discrete time signal.	L3
CO 4	To examine the realization of digital filters using different realization structures.	H1
CO 5	To design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters for processing of discrete time signals.	H3

Course Contents

UNIT-1

DISCRETE FOURIER TRANSFORM (DFT): Frequency Domain Sampling and Reconstruction of Discrete-Time signals, Discrete Fourier Transform, DFT as a Linear Transformation, Properties of DFT, Linear filtering methods based on DFT: use of DFT in linear filtering, Filtering of long data Sequences.
FAST FOURIER TRANSFORM (FFT): Fast Fourier Transform Algorithms, Radix-2 and Radix-4 FFT Algorithms, Applications of FFT Algorithms: Efficient Computation of the DFT of Two Real Sequences, Efficient Computation of the DFT of a 2N-Point Real Sequence, use of FFT in Linear filtering and correlation.

UNIT-II

STRUCTURES FOR FIR SYSTEMS: Direct Form Structures, Cascade Form Structures, Frequency Sampling Structures, Lattice Structure.

STRUCTURES FOR IIR SYSTEMS: Direct Form Structures, Signal Flow graphs & Transposed Structures,

Cascade Form Structures, Parallel Form Structures; Lattice & Lattice- Ladder Structures for IIR Systems.

UNIT –III

FIR & IIR FILTER DESIGN: FIR and IIR filters properties, Design of FIR filters: importance of Linear Phase response, Design of linear phase FIR filters using Windows, Desirable Window function properties for FIR filter design, Frequency Sampling method for Linear Phase FIR Filter Design. Design steps for IIR Filter design, Design of IIR low pass analog filters: Butterworth, Chebyshew, Elliptic; Conversion of analog system to digital system by: Approximation of Derivatives, Impulse Invariance, Bilinear Transformation, Frequency Transformations.

UNIT-IV

MULTIRATE DIGITAL SIGNAL PROCESSING: Introduction to Multirate digital signal processing, interpolation and decimation, sampling rate conversion by rational factor, filterdesign and implementation for sampling rate conversion, multistage decimator and interpolators, Applications of Multirate Signal Processing.

TEXT 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.

REFERENCE BOOKS:

1. L. R. Rabiner & B. Gold, "Theory and Application of Digital Signal Processing", Prentice Hall India.
2. A. V. Oppenheim, R. W. Schafer, J. R. Buck, "Discrete-Time Signal Processing", Prentice Hall India.
3. A. V. Oppenheim, R. W. Schafer, "Digital Signal Processing", Prentice Hall India.
4. Salivahanan, Vallavaraj and Gnanapriya, "Digital Signal Processing", TMH.

Course Articulation Matrix:

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

CONTROL SYSTEM ENGINEERING
PC/ECE/13-T

General Course Information

Course code: PC/ECE/13-T Course Credits: 4 Mode: Lectures (L) Teaching schedule L T P : 3 1 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Mathematics, Physics, Electrical Technology

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define various types of control systems and feedback control mechanism.	L1
CO 2	To describe various time domain and frequency domain tools used for the analysis and design of linear control systems.	L2
CO 3	To illustrate and interpret time domain analysis of 2^{nd} order system.	L3
CO 4	To test the stability of the system using techniques based on transfer function of system.	H1
CO 5	To evaluate and design compensation networks and controllers.	H2

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 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: Synchronous, servomotors, stepper motors, magnetic amplifier.

TEXT BOOK:

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

REFERENCE BOOKS:

1. Modern Control Engg: K. Ogata; PHI. Publishers.
2. Control Systems - Principles & Design: Madan Gopal; Tata Mc Graw Hill. Publishers.
3. Modern Control Engineering, R.C. Dorf & Bishop; Addison-Wesley Publishers.

Course Articulation Matrix:

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

COMPUTER ARCHITECTURE & ORGANIZATION
PC/ECE/14-T

General Course Information

Course code: PC/ECE/14-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Digital Electronics and computer systems.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Outline the general concepts of digital electronics and computer organization and Architecture	L1
CO 2	Discuss the basic components and their interfacing.	L2
CO 3	Apply instructions for performing different operations	L3
CO 4	Analyze the effect of addressing modes on the execution time of a program	H1
CO 5	Evaluate the performance of different types of memory, processing and access methods	H2
CO 6	Design of simple computer with different instruction sets.	H3

Course Contents

UNIT I

INTRODUCTION: Boolean algebra and Logic gates, Combinational logic blocks (Adders, Subtractors, Multiplexers, Encoders, Decoders, Demultiplexers, K-Maps), Sequential logic blocks (Flip-Flops, Registers, Counters).
REGISTER TRANSFER & MICRO OPERATIONS: Register transfer language, register transfer, bus and memory transfer, Micro-operation (Arithmetic, Logic and Shift microoperations), Arithmetic logic shift unit.

UNIT II

COMPUTER ORGANIZATION AND DESIGN: Store program control concept, computer registers and instruction, timing and control, instruction cycle, memory reference instruction, input-output and interrupt, design of basic computer and accumulator logic.
MICRO PROGRAMMED CONTROL: Control memory, address sequencing, microinstruction formats, micro-program sequencer, Implementation and design of control unit.

UNIT III

CPU & PARALLEL PROCESSING: Introduction of central processing unit, general register organization, stack organization, instruction format, addressing mode and its type (register, immediate, direct, indirect, indexed), operations in the instruction set, Instruction set based classification of processors (RISC, CISC, and their comparison), parallel processing, introduction of Pipelining and its type (Arithmetic, Instruction and RISC pipelining). vector and array processing.

UNIT IV

MEMORY HIERARCHY & I/O TECHNIQUES: The need for a memory hierarchy, Type of Memory: Main memory (Semiconductor RAM & ROM organization, memory expansion, Static & dynamic memory types), Auxiliary memory (Magnetic tape and Magnetic Disk), Cache memory (Associative & direct mapped cache organizations), Virtual memory and Associate memory. Memory parameters: (Access/ cycle time, cost per bit), Memory management, input output interface, mode of transfer, DMA (Direct memory transfer).

T**ext and Reference Books:**

1. Mano, M. Morris, Digital Logic and Computer Design, Prentice Hall of India Pvt. Ltd., 1981.
2. M. Morris Mano, Computer System Architecture, Prentice Hall of India Pvt. Ltd., 1993.
3. Milles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization, An Integrated Approach, JohnWiley & Sons Inc., 2007.
4. William Stallings, 10th edition, Computer Organization and Architecture, Prentice Hall, 2016.
5. Heuring, V.P., Jordan, H.F., Computer Systems Design and Architecture, Addison Wesley, 1997.
6. R.P Jain, Modern Digital Electronics, 3rd Edition, Tata McGraw Hill,, 2003.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**1**	**-**	**2**	**2**	**2**	**2**
CO2	**3**	**3**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**1**	**-**	**2**	**3**	**3**	**3**
CO3	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**-**	**2**	**3**	**3**	**3**

Microprocessors and Microcontroller Lab

PC/ECE/11-P

General Course Information

Course code: PC/ECE/11-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD along with the internal assessment marks.

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

Sr. No.	Course outcomes At the end of the course, students will be able to:	RBT Level
CO1	Describe the working of microprocessor kit/ TASM.	(LOTS: Level 3: Apply)
CO2	Apply interfacing of supporting chips with microprocessor	(LOTS: Level 3: Apply
CO3	Design assembly language programs for the 8085 and 8086 microprocessors.	(HOTS: Level 6: Create)
CO4	Analyse the output of assembly language programs	(HOTS: Level 4: Analyse)
CO5	create lab records for the solutions of assignments	(HOTS: Level 6: Create).

List of Experiments

1. Study of architecture of 8085 & familiarization with its hardware, commands & operation of Microprocessor kit.

2. Write a program using 8085 and verify for:

(i) Addition of two 8-bit numbers.

(ii) Addition of two 8-bit numbers (with carry).

3. Write a program using 8085 and verify for:

(i) 8-bit subtraction (display borrow)

(ii) 16-bit subtraction (display borrow)

4. Write a program using 8085 for multiplication of two 8- bit numbers by repeated addition method.

5. Write a program using 8085 for multiplication of two 8- bit numbers by bit rotation method and verify.

6. Write a program using 8085 for division of two 8- bit numbers by repeated subtraction method and test for typical data.

7. Write a program using 8085 for dividing two 8- bit numbers by bit rotation method and test for typical data.

8. Write a program using 8086 and verify for:

(i) Finding the largest number from an array.

(ii) Finding the smallest number from an array.

9. Write a program using 8086 for arranging an array of numbers in descending order and verify.

10. Write a program using 8086 for arranging an array of numbers in ascending order and verify.

14. Write a program to interface a two-digit number using seven-segment LEDs using of 8051 Microcontroller.

15. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller

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

CO-PO Articulation matrix: Microprocessors and Microcontroller Lab (PC/ECE/11-P)															
List of Course outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1: Describe the working of microprocessor kit/ TASM.	2	-	-	-	1	-	-	-	-	-	-	1	3	1	2
CO2: Apply interfacing of supporting chips with microprocessor	2	-	-	-	1	-	-	-	-	-	-	1	3	1	3
CO3: Design assembly language programs for the 8085 and 8086 microprocessors.	2	2	-	2	-	-	-	-	1	-	-	-	3	-	3
CO 4: Analyse the output of assembly language programs	-	-	1	1	2	-	-	-	-	3	-	-	-	-	-
CO5: create lab records for the solutions of assignments	-	-	-	-	-	-	-	3	3	-	-	3	-	3	-
Level of attainment															

DIGITAL SIGNAL PROCESSING LAB
PC/ECE/12-P

Course code: PC/ECE/12-P Course Credits :1 Contact Hours: 2/week Mode: Lab Work	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 Il) 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 Il 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 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/HOD along with the internal assessment marks.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	To understand the basic operations of signal processing & plot basic discrete/digital signals using MATLAB.	L2
CO 2	To demonstrate interpolation and decimation operations using MATLAB.	L3
CO 3	To analyze and examine the sampling theorem.	H1
CO 4	To evaluate magnitude and phase spectrum of a discrete time signal using DFT to determine the spectral components of the signal.	H2
CO 5	To develop and design IIR and FIR band pass, band stop, low pass and high pass filters using MATLAB.	H3

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 generate DTMF signals using MATLAB.
14. To develop program for stability test using MATLAB.
15. To develop a program for computing inverse Z-transform of a rational transfer function.
16. To develop a program for computing parallel realization values of IIR digital filter.
17. To develop a program for computing cascade realization values of IIR digital filter.

Note: At least ten experiments are to be performed in the semester, out of which minimum eight 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.

Course Articulation Matrix:

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

Fundamentals of Management

HSMC/3-T

General Course Information:

Course code: HSMC/3-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course outcomes At the end of the course students will be able to:	RBT* Level
CO1.	To develop the basic understanding of the concept of management and functions of management.	**Level 3** **(Applying)**
CO2.	The students will come to know about Human Resource management and Marketing management functions of management.	**Level 2** **Understanding**
CO3.	Students will come to know about the production activities of any manufacturing organisations.	**Level 2** **Understanding**
CO4.	To know that how finances are arranged and disbursed for all the activities of business organisations.	**Level 4** **Analyzing**

***Revised Bloom's Taxonomy Action verbs/Levels**

Unit-I

Concept of Management: Definitions, Characteristics, Significance, Practical Implications; Management Vs. Administration; Management- Art, Science and Profession; Development of Management Thoughts; Managerial Functions.

Unit-II

Concept of Human Resource Management: Human resource planning; Recruitment, Selection, Training and Development, Compensation; Concept of Marketing Management: Objectives and functions of Marketing, Marketing Research, Advertising, Consumer Behavior.

Unit-III

Concept of Production Management, Production Planning and Control, Material management, Inventory Control, Factory location and Production Layout.

Unit-IV

Concept of Financial Management, Capital Structure and various Sources of Finance, Working Capital, Short term and long-term finances, Capital Budgeting.

TEXT BOOK:

1. Principles and Practices of Management: R. S. Gupta, B. D. Sharma, N. S. Bhalla; Kalyani Publishers.
2. Organization and Management: R. D. Aggarwal; Tata McGraw Hill.

REFERENCE BOOKS:

1. Marketing Management: S. A. Sherlikar; Himalaya Publishing House.
2. Financial Management: I.M. Pandey; Vikas Publishing House.
3. Production Management: B. S. Goel; Himalaya Publishing House.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1.	3	2	1		-	-	-	-	-	-	3	-
CO2.	3	2	1	-	-	-	-	-	-	-	3	-
CO3.	1	2	3	-	-	-	-	-	-	-	3	-
CO4.	1	2	3	-	-	-	-	-	-	-	3	-
3 –High 2-Medium 1-Low												

Industrial training/Internship-I

EEC/ECE/1-P

General Course Information:

Course code: EEC/ECE/1-P Course Credits: 4.0 Type: Compulsory Contact Hours: 0 hours per week (L-T-P: 0-0-0) Mode: Practical	**Course Assessment Methods (Internal: 100)** Assessment of Industrial Training/Internship-I will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of 4th sem.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Outline technical documents and give oral presentations related to the work completed	L1
CO 2	Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the industry	L2
CO 3	Acquire and apply fundamental principles of engineering and an ability to work in actual working environment.	L3
CO 4	Analyze practical application of the subjects taught during the course	H1
CO 5	Develop social, cultural, global and environmental responsibilities as an engineer	H2
CO 6	Identify, formulate and model problems and find engg. Solution based on a system approach	H3

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

Detailed Syllabus of B.Tech.(ECE) VI Semester

COMPUTER NETWORKS and IOT
PC/ECE/15-T

General Course Information:

Course code: PC/ECE/15-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand networking of devices & describe the concepts of IOT.	L1
CO 2	Identify the different technologies used for information transfer.	L2
CO 3	Apply IOT to different applications.	L3
CO 4	Analysis and evaluate protocols used in IOT.	H1
CO 5	To analyze the data transfer on networks and troubleshooting of various possible errors.	H2
CO 6	Design and develop smart city in IOT.	H3

Course Contents

UNIT-I

Introduction: Uses of Computer Networks, History of computer networks, Introduction to models and layers: OSI & TCP/IP model.
Data Link Layer & LAN: Error-detection and correction techniques, Multiple access protocols, addressing, Ethernet, switches.

UNIT-II

Transport Layer: Connection less transport (UDP), Principles of reliable data transfer, Connection oriented transport (TCP), Congestion control.
Network Layer: Introduction, Virtual and Datagram networks, study of router, IP protocol and addressing in the Internet

Application Layer: Web and HTTP, E-mail, DNS.

UNIT-III

Network Security & latest IEEE trends TEBE standards- 802.3, 802.4, 802.5, 802.11, 802.15, 802.16, 802.20, 802.22.

Network security- model for network security, RSA algorithm, Digital Signature, security, Firewalls, VPNs, Proxy servers.

UNIT-IV

Internet of things 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

TEXT BOOKS:

1. Data Communications and Networking (4th edition), Behrouz Forouzan, McGraw Hill
2. Internet of Things, Principles and Paradigms; Rajkumar Buyya, Elsevier

REFERENCE BOOKS:

1. Computer Networks; By: Tanenbaum, Andrew S; Pearson Education Pte. Ltd., Delhi,4th Edition
2. Computer Networks- A Top-Down approach, Behrouz Forouzan, McGraw Hill
3. The Internet of Things: From RFID to the Next-Generation Pervasive Networked LuYan, Yan Zhang, Laurence T. Yang, Huansheng Ning
4. Internet of Things (A Hands-on-Approach) , Vijay Madisetti , ArshdeepBahga
5. Designing the Internet of Things , Adrian McEwen (Author), Hakim Cassimally 6. Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO2	3	3	2	2	3	3	2	-	3	2	2	2	3	3	2
CO3	3	3	2	2	2	3	1	-	3	2	2	2	3	3	3
CO4	3	3	3	2	3	3	1	2	2	2	3	2	3	3	3
CO5	3	3	3	2	3	3	2	2	2	3	3	2	3	3	2
CO6	3	3	3	2	2	3	2	2	3	3	3	2	3	3	3

VLSI DESIGN
PC/ECE/16-T

General Course Information:

Course code: PC/ECE/16-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered, class performance through percentage of lectures attended (4 Marks), assignments, quiz etc. (6 Marks), and end semester examination 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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Analog Electronics and Digital Electronics

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the MOS technology and its applications for VLSI design.	L1
CO 2	Illustrate the design equations and their analysis for VLSI circuit system.	L2
CO 3	Demonstrate the importance of CMOS design in VLSI system design.	L3
CO 4	Compare the various circuit topologies for digital VLSI design	H1
CO 5	Define and evaluate the layout of VLSI circuits.	H2
CO 6	Develop or create CMOS system for VLSI design.	H3

Course Contents

UNIT-I

VLSI FABRICATION: Crystal growth, oxidation, diffusion, ion implantation, epitaxy, photolithography, etching, dielectric and polysilicon film deposition, metalization.

MOS TECHNOLOGY: Introduction to IC technology, MOS Transistor enhancement mode and depletion mode operations, fabrication of NMOS, CMOS and BiCMOS devices. Equivalent circuit for MOSFET and CMOS.

UNIT-II

MOS TRANSISTOR THEORY: MOS device design equations, Electrical Properties of MOS Circuits: Ids-Vds relationships, MOS transistor threshold Voltage, Body effect,channel length Modulation, MOS Transconductance, Figure of merit, Pass-transistor, NMOS Inverter, determination of Pull up to Pull down ratio for NMOS inverter driven by another NMOS inverter and one or more Pass transistor, CMOS Inverter,Bi-CMOS Invertor, Latch up.

UNIT-III

MOS CIRCUIT DESIGN PROCESS: MOS layer, stick diagram: NMOS Design style, PMOS Design style, CMOS design style, design rules and layout: lambda based design rule, layer representation, contact cuts, double metal MOS process rules, CMOS lambda based design rules.

BASIC CIRCUIT CONCEPT: Sheet Resistance and its concept to MOS, Area Capacitance Units, Calculations: Delays, Driving large Capacitive Loads, Wiring Capacitances, Fan-In/Fan-out.

UNIT-IV

SCALING OF MOS CIRCUITS: Scaling models and scaling factors for device parameters, limitations of scaling: substrate doping, limits of miniaturization, limit of interconnect and contact resistance.

CMOS DESIGN: Gate Logic: inverter, nand gate, nor gate. Ratioed logic, pseudo NMOS logic, DCVSL Logic, Switch Logic: pass transistor and transmission gate, dynamic logic, charge sharing logic, domino logic

DESIGN EXAMPLE USING CMOS: Logic gates, Parity generator, Multiplexers, gray code to binary code converter, Incrementer/ decrementer, two phase clocking.

TEXT BOOKS :

1. Basic VLSI Design:Douglas A. Pucknell;PHI
2. Principles of CMOS VLSI Design : Neil H.E. Weste and Kamran Eshraghian; Pearson.
3. Integrated Circuits: K.R. Botkar; Khanna

REFERENCE BOOKS :

1. Introduction to Digital Circuits : Rabaey LPE (PHI)
2. VLSI Fabrication: S.K.Gandhi, Wiley.
3. VLSI Technology: S.M. Sze; McGraw-Hill.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	2	1	1	2	1	-	2	3	3	2
CO2	3	3	2	2	1	2	2	1	2	1	-	2	3	3	2
CO3	3	3	2	2	1	2	1	-	2	2	-	2	3	3	2
CO4	3	3	3	2	-	2	1	-	2	2	-	2	3	3	3
CO5	3	3	3	2	-	2	2	1	2	2	-	2	3	3	3
CO6	3	3	3	2	1	2	2	1	2	1	-	2	3	3	3

Microwave and Radar Engineering

PC/ECE/17-T

General Course Information:

Course code: PC/ECE/17-T Course Credits: 3.0 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt 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
CO 1	To define the basic concepts of waveguide & wave propagation	L 1
CO 2	To Illustrate the operations and principals of various microwave components and devices	L 2
CO 3	To describe the microwave component layouts.	L 3
CO 4	To examine the performance of different microwave devices.	H 1
CO 5	To design different microwave component structures for various applications.	H 2
CO 6	To Evaluate the performance of active microwave devices.	H 3

Course Contents

UNIT-1

WAVEGUIDES & MICROWAVE COMPONENTS: Introduction, propagation in TE and TM mode, rectangular wave guide, tem mode in rectangular wave guide, characteristic impedance, introduction to circular waveguides and planar transmission lines, s-parameters, scattering matrix and its properties, directional couplers, microwave tees, irises, posts and tuning screws, attenuators, cavity resonators, re-entrant cavities, mixers & detectors, matched load, phase shifter, wave meter, ferrite devices

UNIT-II

MICROWAVE TUBES & MEASUREMENTS: Limitation of conventional tubes;Construction and Operation Principal of Two Cavity Klystron amplifier, Reflex Klystron, Magnetron (Cylindrical Magnetron and description of II mode), TWT, BWO, Crossed field amplifiers, Measurement of Power, VSWR, frequency, attenuation, insertion loss, wavelength and impedance.

UNIT –III

MICROWAVE SOLID STATE DEVICES: Transferred Electron Devices- GUNN EFFECT; Negative Differential Resistance Phenomenon, field domain formation, GUNN diode structure, Varactor diode, Tunnel diode, Schottky diode, IMPATT, TRAPATT, BARITT and PIN diodes. MASER, Parametric amplifiers.

UNIT –IV

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.

TEXT BOOKS:

1. Microwave devices and circuits: Samuel Liao; PHI.
2. Microwave devices & Radar Engg: M. Kulkarni; Umesh Publications.
3. Microwave Engineering: Annapurna Das, S. K. Das, MCGraw Hill Education.

REFERENCE BOOKS:

1. Microwaves and Radar: A.K. Maini; Khanna.
2. Microwave Engineering, David M. Pozar, Wiley.
3. Microwave & Radar Engg, Dr. A. K. Gautam, katson Books.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	2	1	1	2	2	-	2	3	3	2
CO2	3	3	2	2	2	2	2	-	2	2	-	2	3	2	2
CO3	3	3	2	2	1	2	2	-	2	1	-	2	3	3	3
CO4	3	3	3	2	1	2	1	1	2	1	-	2	3	3	2
CO5	3	3	3	2	2	-	2	1	2	1	-	2	3	2	3
CO6	3	3	3	2	1	1	2	1	2	2	-	2	3	3	3

COMPUTER NETWORKS & IOT LAB
PC/ECE/15-P

Course code: PC/ECE/15-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD along with the internal assessment marks.

Pre-requisites: Basic knowledge of the inter-computer, internet connections and addressing.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To understand the concept of internetworking of devices.	**L1**
CO 2	To describe application of IOT.	**L2**
CO 3	To make use of Devices, Gateways and Data Management in IOT.	**L3**
CO 4	To design the computer links among different networks to transfer the information.	**H1**
CO 5	To evaluate the Market perspective of IOT.	**H2**
CO 6	To design state of the art architecture in IOT.	**H3**

List of Experiments

1. Configure a network topology using packet tracer software.
2. To establish a Web Server Connection Using the PC's Web Browser.
3. Viewing Device Tables and Resetting the Network.
4. To establish a full duplex network using routers.
5. Hands on experience on Node MCU board (installation, install ESP8266 board in Arduino IDE, flashing Node MCU firmware on the ESP8266).
6. To control LED using IoT on Node MCU board.
7. To study PIR Motion Sensor using Node MCU board.
8. To study web server with Arduino IDE.
9. To publish Temperature Readings using ADC.
10. To study Weather Forecaster.
11. To study Door Status Monitor.
12. To study Servo motor control using Node MCU board.
13. 13. To study RGB Color Picker using Color Sensor
14. Hands on experience on Raspberry Pi.

NOTE: Eight experiments are to be performed out of which at least Six experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	3	1	1	2	2	2	2	3	3	2
CO2	3	3	2	2	2	3	1	-	2	2	2	2	3	3	2
CO3	3	3	2	2	3	3	2	1	3	2	2	2	3	3	2
CO4	3	3	3	2	3	3	2	2	2	3	3	2	3	3	3
CO5	3	3	3	2	3	3	-	2	3	3	3	2	3	3	3
C06	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3

VLSI DESIGN LAB

PC/ECE/16-P

Course code: PC/ECE/16-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD along with the internal assessment marks.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	Describe the CMOS technology and its applications for VLSI design.	L1
CO 2	Illustrate the VLSI circuit design techniques practically.	L2
CO 3	Demonstrate the importance of CAD tools in VLSI system design.	L3
CO 4	Compare the various circuit topologies for digital VLSI design.	H1
CO 5	Design and evaluate the layout of VLSI circuits.	H2
CO 6	Develop or create CMOS system using VLSI CAD tools.	H3

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.
12. 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 minimum six 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.

Course Articulation Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	2	3	1	-	2	3	2	2	3	3	2
CO2	3	3	2	2	3	3	2	-	3	2	2	2	3	3	2
CO3	3	3	2	2	2	3	1	-	2	3	2	2	3	3	2
CO4	3	3	3	2	2	3	1	2	3	3	3	2	3	3	3
CO5	3	3	3	2	2	3	2	2	3	2	3	2	3	3	3
CO6	3	3	3	2	3	3	1	2	2	2	3	2	3	3	3

Microwave Engineering Lab

PC/ECE/17-P

Course code: PC/ECE/17-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To state the practical concepts of generation of microwave signal	L1
CO 2	To describe the various parameters related to microwave components.	L2
CO 3	To classify various microwave components	L3
CO 4	To Examine the microwave frequency signals and how it is measured.	H1
CO 5	To evaluate microwave systems for different practical application.	H2
CO 6	To create a model for microwave frequency generation.	H3

List of Experiments

1. Study of wave guide components.
2. To study the characteristics of Reflex Klystron and determine its tuning range.
3. To measure frequency of microwave source and demonstrate relationship among guide dimensions, free space wave length and guide wavelength.
4. To measure VSWR of unknown load and determine its impedance using a smith chart.
5. To match impedance for maximum power transfer using slide screw tuner.
6. To measure VSWR, insertion losses and attenuation of a fixed and variable attenuator.
7. To measure coupling and directivity of direction couplers.
8. Study of Power Division in Magic Tee.
9. To measure insertion loss, isolation of a three-port circulator.
10. To measure the Radiation Pattern and Gain of Waveguide Horn Antenna.
11. To study the V-I characteristics of GUNN diode.

Note: At least eight experiments are to be performed in the semester, out of which minimum six 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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	1	2	2	2	2	3	3	3
CO2	3	3	3	2	3	3	2	-	3	3	2	2	3	3	2
CO3	3	3	3	2	3	2	1	-	3	2	2	2	3	3	3
CO4	3	3	3	2	2	3	1	2	2	3	3	2	3	2	2
CO5	3	3	3	2	2	3	2	2	2	3	3	2	3	3	3
CO6	3	3	3	2	3	2	1	2	2	2	3	2	3	3	2

SKILLS & INNOVATION LAB

PC/ECE/18-P

Course code: PC/ECE/18-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD 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	Describe Circuit schematic design, PCB layout design and fabrication process.	L1
CO 2	To understand and explain PCB design and fabrication process.	L2
CO 3	To apply, implement, execute the knowledge of electronic circuit design, layout design and fabrication process.	L3
CO 4	To investigate Circuit schematic design, PCB design and fabrication process.	H2
CO 5	To design and construct PCB for electronic circuits.	H3

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 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.

Course Articulation Matrix:

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

Economics for Engineers
HSMC/4-T

Course code: HSMC/4-T Course Credits: 2 Mode: Lectures (L) Teaching schedule L T P: 2 0 0 Examination Duration: 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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: None

About the Course: This course is designed to provide the elementary and essential knowledge of economics relevant to their profession as engineers. The graduating engineers will learn about the basic principles of economics and cost benefit analysis for various economic alternatives. The course also gives an initial exposure to issues and challenges for sustainable development.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	The principles of economics in general and economics in Indian context	LOTS: Level 1: Remember
CO 2	Concepts related to economics in general and particularly relevant to Indian scenario.	LOTS: Level 2: Understand
CO 3	The principles of economics for solving problems related to Engineering sector.	LOTS: Level3: Apply
CO 4	Cost/benefit/, life cycle and breakeven analyses on one or more economic alternatives.	HOTS: Level 4: Analyse
CO 5	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 economics 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. 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 EconornicTheory, 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.**Course Articulation Matrix:**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO13	PSO14	PSO15
CO1	1	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	1	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	2	2	2	2	2	-	-	-	-	-	-	3	-	-	-
CO4	3	-	2	3	3	-	-	-	2	-	-	3	-	-	-
CO5	3	-	3	3	-	-	3	-	-	3	3	3	-	-	-

Detailed Syllabus
of
B.Tech.(ECE)
VII Semester

DIGITAL SYSTEM DESIGN
PC/ECE/19-T

Course code: PC/ECE/19-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 Circuits, Microprocessor and its Applications

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe digital system design process.	L1
CO 2	Explain various design methodologies for digital system design.	L2
CO 3	Apply the knowledge of digital design techniques for system design.	L3
CO 4	Demonstrate the use of HDL in Digital systems design.	H1
CO 5	Evaluate and compare different design techniques available for digital logics	H2
CO 6	Design the specifications for the system to be created/implemented using HDL	H3

Course Contents

UNIT I

Benefits of CAD, Design abstractions, Digital system design process, Computer aided design tools for digital systems, Hardware Description Languages, introduction to VHDL/Verilog and its capabilities, VHDL-data objects, classes and data types, operators, overloading, logical operators, types of delays, Entity and Architecture declaration. Introduction to behavioral, dataflow and structural models, Hierarchical Modeling Concepts: Design Methodologies.

UNIT II

Assignment statements, sequential statements and process, conditional statements, case statement Array and loops, resolution functions, Packages and Libraries, concurrent statements. Subprograms: Application of Functions and Procedures, Structural Modelling, component declaration, structural layout and generics.

UNIT III

VHDL Models and Simulation of combinational circuits such as Multiplexers, De-multiplexers, encoders, decoders, code converters, comparators, implementation of Boolean functions etc, VHDL Models and Simulation of Sequential Circuits, Shift Registers, Counters etc.

UNIT IV

Design with PLDs, Programmable logic devices: ROM, PLAs, PALs, CPLDs and FPGA, Design implementation using ROM, PLA, PAL, CPLDs and FPGAs. Basic components of a computer, specifications, architecture of a simple microcomputer system, implementation of a simple microcomputer system using VHDL

Text Books:

1. Introduction to Digital Systems: Milos Ercegovac, T Lang, and J H Moreno, Wiley-2014
2. VHDL Modular design and synthesis of Cores and systems: Z Navabi, McGraw Hill, 2014
3. VHDL Analysis and Modeling of Digital system : Z Navabi, McGraw Hill, 2nd Ed

References Books:

1. A VHDL Primer: J Bhaskar, PHI 1995.
2. Digital Design with introduction to HDL: Mano and Ciletti, Pearson 2013.
3. VHDL Synthesis: A Practical Primer; J Bhaskar, BS Publication 2001
4. Digital System Design Using VHDL: Charles H Roth, Jr: Thomson Books/Cole 1998
5. Verilog Digital system Design: Z Navabi; McGraw Hill, 2nd Ed 2006.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	1	-	2	1	-	3	3	2	2
CO2	3	3	2	2	2	3	2	-	2	2	-	3	3	3	3
CO3	3	3	2	2	2	3	2	-	2	2	-	3	3	2	2
CO4	3	3	3	3	2	3	1	1	2	2	-	3	3	3	2
CO5	3	3	3	3	3	3	1	1	2	1	-	3	3	3	3
CO6	3	3	3	3	3	3	1	1	2	1	-	3	3	2	3

Mobile Communication and Networks

PC/ECE/20-T

Course code: PC/ECE/20-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 Circuits, Microprocessor and its Applications

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Understand basic concepts of cells and channels	L1
CO 2	Understand the working principles of the mobile communication systems	L2
CO 3	Understand the relation between the user features and underlying technology.	L3
CO 4	Analyse mobile communication systems for improved performance	H1
CO 5	Evaluate and compare different technologies	H2

Course Contents

UNIT I

Cellular concepts- Cell structure, frequency reuse, cell splitting, channel assignment, handoff, call drop, interference, capacity, power control; Wireless Standards, Introduction to Generations – 2G to 5G.

Unit II

Signal propagation- Propagation mechanism- Reflection, Refraction, Diffraction and Scattering, Large scale signal propagation, Fading channels-Multipath and small scale fading- Doppler shift, Statistical multipath channel models, Narrowband and Wideband fading models, Delay spread, Coherence bandwidth and Coherence time, Flat and frequency selective fading, Slow and Fast fading, Average fade duration and level crossing rate.

Unit III

Orthogonal Frequency Division Multiplexing (OFDM) – OFDM Receiver & Transmitter structures- Diversity receivers- selection and MRC receivers, RAKE receiver, Equalization, Transmit diversity-Altamonte scheme.

Unit IV

MIMO and Space time signal processing - Spatial multiplexing, diversity/multiplexing tradeoff, Performance measures- Outage, SNR, symbol/bit error rate, examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall,1996.
6. T.S. Rappaport, Wireless Communications: Principles and Practice, 2nd Edition, Pearson Education Asia, 2010.

Course Articulation Matrix:

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

DIGITAL SYSTEM DESIGN LAB
PC/ECE/19-P

General Course Information

Course code: PC/ECE/19-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 Il 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 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the use of HDLs for VLSI digital system design.	L1
CO 2	Illustrate the various CAD tools available for Digital system design.	L2
CO 3	Demonstrate the importance of HDL and CAD tools in VLSI digital system design.	L3
CO 4	Compare the various design techniques for digital system design.	H1
CO 5	Design and evaluate the performance of digital systems.	H2
CO 6	Develop or create digital system using HDLs and FPGAs.	H3

List of Experiments

1. Familiarization with VHDL/Verilog and CAD tools.
2. Design all digital logic gates using VHDL.
3. Design a half adder digital logic using VHDL.
4. Design a 3-to-8 Decoder using 1-to-2 Decoder using VHDL.
5. Design a 8-to-1 MUX using 2-to-1 MUX using VHDL.
6. Design 1-bit full adder using 2x1 Multiplexer in VHDL.
7. Design a 4-Bit Comparator using VHDL.
8. Design all logic gates and 4-bit Full Adder using VHDL.
9. Design a 4-bit Full Adder-Subtractor using VHDL.
10. Design a 4-bit ALU using VHDL.
11. Design a D-latch D-FF using VHDL.
12. Design register, shifter and counter using VHDL.
13. FPGA implementation of 4bit Counter using VHDL.
14. FPGA implementation of Finite state machine using VHDL.
15. FPGA implementation of 7-segment decoder using VHDL.
16. Write VHDL code to display messages on an alpha numeric LCD display.

NOTE: At least twelve experiments are to be performed out of which at least eight experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	3	3	2	3	1	-	2	2	3	3	3	2	2
CO2	3	3	3	3	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	3	3	3	3	2	-	3	3	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

MINOR PROJECT

EEC/ECE/3-P

Course code: EEC/ECE/3-P Course Credits: 4 Contact Hours: 8/week (L-T-P: 0-0-8) Mode: Lab Work	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 Il) 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 Il 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 tothe 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Relate practical knowledge within the chosen area of technology for project development	L1
CO 2	Understand methodologies and professional way of documentation and communication.	L2
CO 3	Illustrate the key stages in development of the project.	L3
CO 4	Identify, analyze, formulate and handle projects with a comprehensive and systematic approach	H1
CO 5	Contribute as an individual or in a team in development of technical projects	H2
CO6	Develop effective communication skills for presentation of project related activities	H3

NOTE: 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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	2	3	2	-	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	3	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	2	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	2	3	3	3	3	2	2

Industrial training/Internship-II

EEC/ECE/4-P

General Course Information:

Course Code: EEC/ECE/4-P Course Credits: 2 Type: Compulsory Contact Hours: 4 hours per week (L-T-P: 0-0-4) Mode: Practical	**Course Assessment Methods (Internal: 100)** Assessment of Industrial training/Internship-II will be based on presentation/seminar delivered, viva-voce, report and certificate for the practical training taken at the end of VI sem.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Outline technical documents and give oral presentations related to the work completed	L1
CO 2	Recognize the need for, and have the preparation and ability to engage in independent and life- long learning in the industry	L2
CO 3	Acquire and apply fundamental principles of engineering and an ability to work in actual working environment.	L3
CO 4	Analyse practical application of the subjects taught during the course	H1
CO 5	Develop social, cultural, global and environmental responsibilities as an engineer	H2
CO 6	Identify, formulate and model problems and find engg. Solution based on a system approach	H3

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	3	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	3	3	3	3	3	2	2

Seminar

EEC/ECE/5-P

Course Code: EEC/ECE/5-P Course Credits: 1.0 Type: Compulsory Contact Hours: 2 hours per week (L-T-P: 0-0-2) Mode: Practical	**Course Assessment Methods (Internal: 100)** Assessment of seminar will be based on presentation/seminar delivered, viva-voce, report.

Guidelines: Select a topic relevant to ECE domain and suitable for UG Level presentation. For Selection topics refer to internationally reputed journals. The primary reference should be published during the last two or three years. Some of the journals/Publications suitable for reference are :IEEE/The IET/IETE/Springer/Science Direct/ACM journals.

Course Outcomes

At the end of the semester, students will be able to:

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Identify contemporary topics/concepts pertaining to recent trends in Electronics and communication engineering and prepare documentation.	L1
CO 2	Acknowledge the necessity and values of concerned topic for future use.	L2
CO 3	Present the selected topic with superiority demonstrating good communication skills.	L3
CO 4	Develop social, cultural, global and environmental responsibilities as an engineer	H1

Course Articulation Matrix:

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

Detailed Syllabus of
B.Tech.(ECE)
VIII Semester

MAJOR PROJECT
EEC/ECE/6-P

Course code:EEC/ECE/6-P Course Credits: 10 Contact Hours: 20/week (L-T-P: 0-0-20) Mode: Lab Work	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 based on implementation, presentation, viva-voce (each of 50 marks) for the laboratory courses (Minor Laboratory Evaluations: MLE I and MLE Il) 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/HOD of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE Il 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 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/HOD office along with the internal assessment marks.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	Extend or use the idea in mini project for major project.	L1
CO 2	Describe a through and systematic understanding of project contents	L2
CO 3	Use effectively oral, written and visual communication	L3
CO 4	Identify, analyse, and solve problems creatively through sustained critical investigation.	H1
CO 5	Demonstrate an awareness and application of appropriate personal, societal, and professional ethical standards.	H2
CO6	Know the key stages in development of the project.	H3

NOTE: 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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	2	3	1	2	2	2	3	3	3	2	2
CO2	3	3	2	2	3	3	2	2	3	3	3	3	3	3	3
CO3	3	3	2	2	3	3	2	-	2	2	3	3	3	2	2
CO4	3	3	3	3	2	3	1	2	3	2	3	3	3	3	3
CO5	3	3	3	3	3	3	1	2	3	2	3	3	3	2	3
CO6	3	3	3	3	2	3	2	2	3	3	3	3	3	2	2

Detailed Syllabus

of

B.Tech.(ECE)

Program Elective Course-I

CONSUMER & INDUSTRIAL ELECTRONICS

PE/ECE/1-T

General Course Information

Course code: PE/ECE/1-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Basics of electronics, Electronics Devices and circuits

Sr. No.	**Course Outcomes:** **At the end of the semester, students will be able:**	**RBT Level**
CO1	Name different types of Audio/Video devices	L1
CO2	Explain the devices on component level	L2
CO3	Illustrate state of the art technology in consumer items	L3
CO4	Examine proper transducer and other constituent components on the basis of particular application.	H1
CO5	Judge the faults in consumer electronic items	H2
CO6	Develop the idea of troubleshooting in consumer electronics items	H3

Course Contents

UNIT-1

AUDIO SYSTEMS: Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity and linearity, Reverberation; Audio level metering, decibel level in acoustic measurement; Microphone: working principle, sensitivity, nature of response, directional characteristics; Types: carbon, condenser, crystal, electrets, tie-clip, wireless; Loud speaker: working principle, characteristic impedance, watt capacity, Types: electrostatic, dynamic, permanent magnet etc , woofers and tweeters; Sound recording: Optical recording, stereophony and multichannel sound, MP3 standard; Audio system: CD player, home theatre sound system, Digital console: block diagram, working principle, applications.

UNIT-II

VIDEO SYSTEMS: Basic block diagram and working of the following: Digital TVs, LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver; Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI Multimedia Interface), Digital Video Interface; CD and DVD player: working principles, interfaces; Touch screen.

UNIT –III

OFFICE GADGETS: Basic block diagram and working of the following: Desktop computer, Mouse, Keyboard, Laptop, Digital Storage Devices; Printer (inkjet, laser and 3D), Scanner, FAX machine, Photocopier, EPABX, Online and Offline UPS, LCD Projector, Bar Coding Machine.

UNIT-IV

HOME GADGETS: Basic block diagram and working of the following: Air Conditioner, Digital Camera/ Camcoder, Refrigerator, Microwave Oven, Mobile Phone Handset, Mobile Charger, RO system, Different types of Batteries, Inverter, Home security and CCTV

TEXT 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 Press

REFERENCE BOOKS:

1. W. Jerry and B. Blair, "Standard Handbook of Audio Engineering", Mc Graw Hill Professional
2. Millman, "Integrated Circuits", Tata Mc Graw Hill Publishers
3. Boylsted, "Electronic Devices and Circuit Theory", Pearson

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**-**	**2**	**-**	**1**	**2**	**1**	**-**	2	1	2	2
CO2	**3**	**3**	**2**	**1**	**1**	**2**	**-**	**1**	**2**	**2**	**-**	2	-	2	2
CO3	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**-**	2	2	3	2
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	**-**	3	1	2	-
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	3	-	-	1
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	**-**	3	-	-	1

LINEAR INTEGRATED CIRCUITS AND APPLICATIONS

PE/ECE/2-T

General Course Information

Course code: PE/ECE/2-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: EDC, Analog Circuits

Sr. No.	Course Outcomes At the end of the semester, students will be able to :	RBT Level
CO 1	To describe linear integrated circuits and their application circuits.	L1
CO 2	To understand and explain operational amplifier circuits and their application circuits.	L2
CO 3	To apply the knowledge of linear integrated circuits.	L3
CO 4	To compare and analyze operational amplifier circuits and their application circuits.	H1
CO 5	To design operational amplifier based comparators and converters.	H3

Course Contents

UNIT I

INTRODUCTION: Block diagram, 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: Interpretation of data sheets, Ideal Op-Amp and its equivalent circuit, Ideal voltage transfer curve, open loop op-amp configurations.

UNIT II

FEEDBACK CIRCUITS: Block diagram representation of feedback configurations. Voltage series feedback amplifier, Voltage shunt feedback amplifier, differential amplifiers.

PRACTICAL OP-AMP: Input offset voltage, input bias current, input offset current, total output offset voltage, thermal drift, effect of variation in power supply voltages on offset voltage, change in input offset voltage and input offset current with time, temperature and supply voltage sensitive parameters, Noise, Common -Mode configuration and common mode rejection ratio.

UNIT III

FREQUENCY RESPONSE: Frequency response of internally compensated and non compensated Op-Amps, High frequency Op-Amp equivalent circuit, open loop voltage gain as a function of frequency, closed loop frequency response, circuit stability, and slew rate.

APPLICATIONS: DC and AC amplifier, Peaking Amplifier, summing, scaling and averaging amplifiers, Instrumentation amplifier, Differential input and output amplifier. Voltage to current converter with floating and grounded load, Very high input impedance circuit. Integrator and differentiator circuit.

UNIT IV

FILTERS & OSCILLATORS: First and second order low pass and high pass Butterworth filter. Band pass and band reject filters. Phase shift and Wien bridge oscillator, square wave generator.

COMPARATOR & CONVERTORS: Basic comparator, Schmitt trigger, comparator characteristics and limitations. Voltage limiters, window detector, voltage to frequency and frequency to voltage converters, A/D and D/A converters, Clippers and clampers, peak detector.

Text Books:

1. Ramakant A. Gayakwad, Op-Amps and linear integrated circuits, 4th edition, Pearson

Reference Books:

1. Bruce Carter and Ron Mancini, Op Amps for Everyone, 5th edition, Elsevier
2. Sergio Franco, Design with operational amplifiers and analog integrated circuits, 3rd edition, McGraw Hill

Course Articulation Matrix:

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

RECENT TRENDS IN COMMUNICATION SYSTEMS

PE/ECE/3-T

General Course Information

Course code: PE/ECE/3-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Basics of communication engineering

Sr. No.	Course Outcomes At the end of the semester:	RBT Level
CO 1	Students will be able to define the wireless network Fundamentals and future evaluation	L1
CO 2	Students will be able to understand about Cognitive Radio and wireless sensor network.	L2
CO 3	Students will be able to apply application of Cognitive Radio in Communication	L3
CO 4	Students will be able to compare the Wireless sensor and Optical network.	H1
CO 5	Students will be able to formulate the LTE based project.	H3

Course Contents

UNIT I

Wireless Network Fundamentals & Future Evolution: Introduction to 4G, OFDM, MIMO, Massive MIMO, Long Term Evaluation (LTE) Technologies, Need of LTE, LTE System Architecture, LTE Operations, LTE

communication protocol. LTE-Advanced and VoLTE., Fundamentals of 5G Mobile Communication, Evolving LTE to 5G capability, 5G Standardization, 5G Spectrum, 5G Architecture & Applications.

UNIT II

Wireless Sensor Network: Introduction of Wireless Sensor Networks, Design Issues, Unique constraints and Challenges, Applications of WSN, MAC layers and routing protocols in WSN, Topology Control in WSNs, Data Retrieval Techniques in WSNs: Sensor databases, distributed query processing, Data dissemination and aggregation schemes, Operating Systems for WSN, Security issues in WSN, Future direction of WSNs.

UNIT III

Cognitive Radios: Cognitive Radio – functions, components and design rules, Challenges to Implement Cognitive Radio, Cognitive Radio Products and Applications. Cognition cycle orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture.

UNIT IV

Optical Networks: WDM, DWDM, CWDM, Radio over fiber: Introduction the concept of radio over fiber, categories, performance and application of radio over Fiber, link design issues in radio over Fiber, MM waves: Introduction, Generation and detection of MM waves, Sub carrier multiplexing and CATV applications.

TEXT BOOKS:

1. Holger Karl and Andreas Willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley and Sons, 2006.
2. Christopher-Cox, "An Introduction to LTE: LTE, LTE-Advanced, SAE, VoLTE and 4G Mobile Communications", Wiley, 1st Edition.
3. Huseyin Arslan, "Cognitive Radio, SDR and Adaptive System", Springer, 2007.
4. Optical Fiber Communications, Gerd Keiser, 2nd Edition.

REFERENCE BOOKS:

1. Erik Dahlman , Stefan Parkvall and Jhoan Skold "5G NR: The Next Generation Wireless Access Technology" Academic Press, 2018.
2. Optical Fiber Communications, John M. Senior, 3nd Edition.
3. Alexander M. Wyglinski, Maziar Nekovee , Thomas Hou, "Cognitive Radio Communications and Networks: Principles and Practice", Elsevier, Ist addition.
4. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, "Software Defined Radio", John Wiley, 2003.
5. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, "Wireless Sensor Network: Technology, Protocols and Application", John Wiley and Sons 1st Ed., 2006

Course Articulation Matrix:

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

DATA STRUCTURE AND ALGORITHM

PE/ECE/4-T

General Course Information

Course code: PE/ECE/4-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Programming in C

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe various types of data structures and operations that can be implemented on these data structures.	L1
CO 2	Demonstrate the use of various data structures and their related operations.	L2
CO 3	Apply data structure to solve computational problems.	L3
CO 4	Compare the suitability of alternative data structures and prescribed operations for various problem situations.	H2
CO 5	Defend solutions with respect to effective storage of data and efficiency of the required operations for solving real world problems.	H3

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. Representing sets and polynomials using 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), Threaded Binary Trees, Binary Search Trees implementation and operations, Priority queues.

UNIT III

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's Shortest path algorithm Hashing, Hash tables, hash function and collision resolution.

UNIT IV

Sequential and binary search, Sorting algorithms: Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort, Count sort, Heap sort, Comparison of searching and sorting techniques based on their complexity analysis, Time and space complexity of algorithms: Asymptotic analysis, Big O, Omega, Theta notations.

T**ext 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.

Reference Books:

1. Robert L. Kruse, Data Structure and Program Design in C, Pearson Education India, 2007.
2. Weiss, M. A., Data Structures and Algorithm Analysis in C++, Addison-Wesley, 2007.
3. Sahni, S., Data Structures, Algorithms, and Applications in C++, WCB/McGraw-Hill, 2001.

Course Articulation Matrix:

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

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-II

FPGA Design
PE/ECE/5-T

General Course Information

Course code: PE/ECE/5-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Analog & Digital Circuits.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe different IC design approaches and tools.	L1
CO 2	Explain the requirements of FPGA implementation.	L2
CO 3	Apply the knowledge of digital design techniques for efficient resource utilization in FPGA design.	L3
CO 4	examine the use of scripts SDF format, user constraint file in FPGA Design.	H1
CO 5	Evaluate and compare design techniques for FPGA implementation of combinational and sequential circuits.	H2
CO 6	Design the specifications for the digital system/circuits to be created/implemented using FPGA.	H3

Course Contents

UNIT I

Introduction to ASICs and FPGAs, FPGA's and its Design Flows, Reconfigurable Devices, FPGA's/CPLD's, Fundamentals of digital IC design, FPGA & CPLD Architectures, Architectures of XILINX, ALTERA Devices, FPGA Programming Technologies

UNIT II

FPGA Logic Cell Structures, FPGA Programmable Interconnect and I/O Ports, Designing with FPGAs, Architecture based coding, Efficient resource utilization, Constrains based synthesis False paths and multi cycle paths, UCF file creation, Timing analysis/Floor Planning, Back annotation, Gate level simulation, SDF Format, Scripts, industry Standard FPGA Tools

UNIT III

FPGA Implementation of Combinational Circuits, FPGA implementation of Sequential Circuits, Timing Issues in FPGA Synchronous Circuits.

UNIT IV

Introduction to Verilog HDL, FPGA design flow with Verilog HDL, FPGA Arithmetic Circuits, FPGAs in DSP Applications, FPGA Microprocessor design, Design FPGA systems at high-level.

TEXT BOOKS:

1. Bob Zeidman, Designing with FPGA and CPLDs, BSP publications @2011.
2. Chan & Murad Digital Design using FPGA, BSP @1994
3. Stephen M Trimberger, FPGA Technology, BSP @2015

REFERENCE BOOKS:

1. Wayne Wolf, "FPGA-Based System Design," Prentice Hall, 2004
2. M. D. Ciletti, “Advanced Digital Design with Verilog HDL,” Prentice Hall, 2002
3. Michael Smith, “Application-Specific Integrated Circuits,” Addison-Wesley, 1997

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	1	2	2	-	2	2	-	2	1	2	2
CO2	1	1	2	2	1	2	2	-	2	1	-	2	-	-	2
CO3	1	1	2	2	1	2	1	-	2	1	-	2	2	-	-
CO4	2	2	3	2	1	2	1	1	2	2	-	2	1	2	-
CO5	1	1	3	2	1	2	2	1	2	1	-	2	-	-	1
CO6	1	1	3	2	1	2	1	1	2	1	-	2	-	-	1

OPTICAL COMMUNICATION

PE/ECE/6-T

Course code: PE/ECE/6-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Dual nature of light, basics of communication

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the principles of optical fiber communication.	L1
CO 2	To classify various components and advantages of optical communication.	L2
CO 3	To demonstrate the operation of LASERs, LEDs and detectors.	L3
CO 4	To compare and differentiate various components and parts of optical communication system according to their application	H1
CO 5	To select the appropriate fiber for communication according to the requirements	H2
CO 6	To analyse and design optical network and understand optical communication systems and networks.	H3

Course Contents

UNIT-I

INTRODUCTION TO OPTICAL COMMUNICATION SYSTEMS: Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model, Different types of optical fibers, Electromagnetic spectrum used for optical communication, block diagram of optical communication system, Advantages of optical fiber communication.

UNIT-II

OPTICAL FIBERS: Optical fibers structures and their types, fiber characteristics: attenuation, scattering, absorption, fiber bend loss, dispersion, material, waveguide, polarized mode dispersion, intermodal and intramodal dispersion, fiber couplers and connectors, OTD.

UNIT-III

OPTICAL SOURCES AND SWITCHES: LEDs and LASERs, Photo-detectors - PIN-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties, internal and external quantum efficiency, Optical switches - coupled mode analysis of directional couplers, electro-optic switches, optical cross connects, Fiber Bragg grating.

UNIT-IV

AMPLIFIERS AND OTHER SYSTEMS: Optical amplifiers - EDFA, Raman amplifier, WDM and DWDM systems. Principles of WDM networks, Non-linear effects in fiber optic links. Concept of self-phase modulation, solutions, SONET, ROF, XPM, FWM, SBS, SRS, fiber to home, fiber to premises, optical transport networks.

TEXT BOOKS:

1. J. Keiser, Fiber Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1997
3. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

REFERENCE BOOKS:

1. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
2. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
3. S.E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979.
4. G. Agrawal, Nonlinear fiber optics, Academic Press, 2nd Ed. 1994.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	-	3	1	-	3	2	-	3	1	2	2
CO2	1	-	-	-	-	-	1	-	2	1	-	3	-	-	2
CO3	-	-	1	-	-	-	2	-	3	1	-	3	2	-	2
CO4	-	-	-	-	-	-	1	-	-	2	-	3	1	2	-
CO5	3	3	3	3	-	3	2	-	-	2	-	3	-	-	1
CO6	3	3	-	3	-	3	2	1	2	1	-	3	-	-	1

EMBEDDED SYSTEM DESIGN

PE/ECE/7-T

General Course Information

Course code: PE/ECE/7-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Microprocessor, Digital electronics.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Describe the evolution of processor architectures.	L1
CO 2	Describe the instruction set of Microcontroller.	L2
CO 3	Apply instruction set in writing assembly language programs.	L3
CO 4	Evaluate the performance of timers and counters in real-time response.	H1
CO 5	Design an Embedded System for various applications.	H2

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.

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:

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.

Reference Books:

1. "Microcontroller Programming, the Microchip PIC", by Julio Sanchez, Maria P. Canton, CRC Press.
2. "Embedded C programming and the microchip PIC" by Richard H. Barnett, Larry O' Cull, Delmar Cengage Learning.

Course Articulation Matrix:

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

OPERATING SYSTEM
PE/ECE/8-T

General Course Information

Course code: PE/ECE/8-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: programming in C and knowledge of computer fundamentals.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	List various functions and design characteristics of operating systems	L1
CO 2	Explain fundamental concepts of operating systems.	L2
CO 3	Apply operating system design concepts for solving problems regarding scheduling, memory management, disk management and deadlocks etc.	L3
CO 4	Analyze the issues related to various operating systems.	H1
CO 5	Design solutions for the memory and process management problems	H3

Course Content

UNIT-I

INTRODUCTORY CONCEPTS: Operating systems functions and characteristics, operating system services and systems calls, system programs, operating system structure. Operating systems generation, operating system services and systems calls. Types of Operating systems: Batch operating system, Time-sharing OS, Distributed operating system, Real-time systems.

FILE SYSTEMS: Types of Files and their access methods, File allocation methods, Directory Systems: Structured Organizations, directory and file protection mechanisms, disk scheduling and its associated algorithms.

UNIT-II

PROCESSES: Process concept, Process Control Block, Operations on processes, cooperating processes. CPU scheduling: Levels of Scheduling, scheduling criteria, Comparative study of scheduling algorithms, Algorithm evaluation, multiple processor scheduling. Critical-section problem, Semaphores.

UNIT-III

STORAGE MANAGEMENT: Storage allocation methods: Single contiguous allocation, non-contiguous memory allocation, Paging and Segmentation techniques, segmentation with paging, Virtual memory concepts, Demand Paging, Page replacement Algorithms, Thrashing.

UNIT-IV

DEADLOCK: System model, Deadlock characterization, Methods for handling deadlocks, Deadlock prevention, Deadlock avoidance, Deadlock detection, Recovery from deadlock. Case Studies: Comparative study of WINDOW, UNIX & LINUX system.

Text Books:

1. Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, 8th Edition, WileyIndian Edition, 2010.
2. Andrew S Tanenbaum, Modern Operating Systems, Third Edition, Prentice Hall India, 2008.
3. Naresh Chauhan, Principles of Operating Systems, Oxford Press, 2014.

Reference Books:

1. D.M. Dhamdhere, Operating Systems, 2nd edition, Tata McGraw Hill, 2010.
2. William Stallings, Operating Systems– Internals and Design Principles, 5th Edition, Prentice Hall India, 2000.

Course Articulation Matrix:

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

FPGA DESIGN LAB

PE/ECE/5-P

General Course Information

Course code: PE/ECE/5-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 /HOD 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 tothe 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the use of HDL for FPGA implementation.	L1
CO 2	Illustrate the various CAD tools available for FPGA design and implementation.	L2
CO 3	Demonstrate the importance of HDL and CAD tools in VLSI digital system design.	L3
CO 4	Compare the various design techniques for digital system design.	H1
CO 5	Evaluate the performance of digital systems on FPGA.	H2
CO 6	Develop or create digital system using HDL and FPGA.	H3

List of Experiments

1. FPGA design with HDLs-familiarization.
2. FPGA implementation of 4-bit adder using HDL.
3. FPGA implementation of ALU using HDL.
4. FPGA implementation of Counter using HDL.
5. FPGA implementation of Finite state machine using HDL.
6. FPGA implementation of 7-segment decoder using HDL.
7. Write HDL code to display messages on an alpha numeric LCD display.
8. Write HDL code to interface Hex key pad and display the key code on seven segment display.
9. Write HDL code to control speed, direction of DC and stepper motor.
10. Write HDL code to accept 8 channel analog signal, Temperature sensors and display the data on LC panel or seven segment display
11. Write HDL code to generate different waveforms (Sine, Square, Triangle, Ramp etc.,) using DAC change the frequency and amplitude.
12. Write HDL code to simulate Elevator operation

NOTE: Ten experiments are to be performed out of which at least six experiments should be performed from above list. The remaining experiments may be performed from the above list or designed and set by concerned institution as per the scope of the syllabus.

Course Articulation Matrix:

	PO1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	2	3	3	2	-	3	2	2	2	1	2	2
CO2	1	-	-	-	-	3	2	-	3	3	2	2	-	2	2
CO3	-	2	-	1	-	3	1	-	2	3	2	2	2	-	-
CO4	-	-	-	-	-	-	1	2	-	-	-	2	1	2	-
CO5	3	3	3	2	2	-	1	2	-	-	3	2	-	-	1
CO6	3	3	3	2	2	-	2	2	2	3	3	2	1	-	1

OPTICAL COMMUNICATION LAB
PE/ECE/6-P

General Course Information

Course code: PE/ECE/6-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 /HOD of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 students. 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/HOD along with the internal assessment marks.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	To define the principles of optical fibre communication.	L1
CO 2	To classify various components and advantages of optical communication.	L2
CO 3	To demonstrate the operation of LASER, LEDs and detectors.	L3
CO 4	To compare and differentiate various components and parts of optical communication system through simulation.	H1
CO 5	To select the appropriate fibre for communication according to the requirements	H2
CO 6	To assemble and design optical network through simulation.	H3

List of Experiments

1. To study the characteristics and parameters of Single mode and multi-mode fibers.
2. To calculate the numerical aperture of fiber.
3. To calculate acceptance angle in fiber.
4. To set up 8- 16 channel WDM systems.
5. To study Optsim simulator.
6. To study optical RoF link on Optsim.
7. To set up an optical communication link using Optsim.
8. To study non linear affects using Optsim.
9. To ascertain BER for various data rates for single and multimode fibers using Optsim 10. To design optical amplifier using Optsim.

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six 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.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	3	1	-	2	3	2	-	3	-	-	-	1	2	2
CO2	1	3	1	-	3	3	1	-	2	-	-	-	-	2	2
CO3	2	3	2	-	2	3	1	-	3	-	-	-	2	3	2
CO4	1	3	1	-	-	-	-	-	3	2	1	2	1	2	-
CO5	2	3	2	-	-	-	-	-	2	3	2	-	-	-	1
CO6	1	3	1	2	2	3	1	2	1	-	-	-	-	-	-

EMBEDDED SYSTEM DESIGN LAB

PE/ECE/7-P

General Course Information

Course code: PE/ECE/7-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 /HOD of the Department. The final practical examination of duration three hours will be conducted only in groups of 20-25 studentsThe 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe the procedure to write a program on MP Lab software.	L1
CO 2	Recognize the various modules available with the development board of PIC Microcontroller.	L2
CO 3	Apply instructions set to write assembly language programs.	L3
CO 4	Analyze real-time response of embedded systems.	H1
CO 5	Design and develop an embedded system using PIC Microcontroller.	H2

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. Servo motor interfacing with PIC Microcontroller.
15. Temperature sensor interfacing with PIC Microcontroller.
16. Accelerometer sensor interfacing with PIC Microcontroller.
17. Simple project (Any topic related to the scope of the course).

NOTE: At least twelve experiments are to be performed in the semester, out of which at least eight 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.

Course Articulation Matrix:

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

OPERATING SYSTEM LAB

PE/ECE/8-P

General Course Information

Course code: PE/ECE/8-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode: Lab Work	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 Il) 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 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/HOD along with the internal assessment marks.

Pre-requisites: Basic programming skills.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	Describe various memory allocation strategies and analysing their performance.	L3
CO 2	Discuss the performances of different process scheduling, protection and security mechanisms.	L3
CO 3	Apply the basic concepts of file system and management, process control, scheduling and communication, as well as memory management.	L3
CO 4	Analyze and implementing various deadlock handling strategies.	H1
CO 5	Evaluate the performance of various page replacement policies by implementing them.	H2
CO 6	Develop and test page fault for different page replacement algorithm.	H3

List of experiments

1. Write a program to implement CPU scheduling for first come first serve.
2. Write a program to implement CPU scheduling for shortest job first.
3. Write a program to perform priority scheduling.
4. Write a program to implement CPU scheduling for Round Robin.
5. Write a program for page replacement policy using a) LRU b) FIFO c) Optimal.
6. Write a program to implement first fit, best fit and worst fit algorithm for memory management.
7. Write a program to implement reader/writer problem using semaphore.
8. Write a program to implement Banker's algorithm for deadlock avoidance.
9. Write a program to implement Banker's algorithm for deadlock prevention.
10. Write a program to implement the following the following file allocation methods: (a) contiguous (b) Linked (c) Indexed .
11. Write a program to simulate the following techniques of memory management:

a) Paging b) Segmentation

12. Write a program to simulate the following File organization techniques:

a) Single level directory b) Two level c) Hierarchical.

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six 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.

Course Articulation Matrix:

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

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-III

WIRELESS SENSOR NETWORKS

PE/ECE/9-T

Course code: PE/ECE/9-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Computer network

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT Level**
CO 1	Describe various research areas and applications of wireless sensor networks.	L3
CO 2	Discuss different routing algorithms.	L3
CO 3	Explain various MAC protocol used in WSN	L3
CO 4	Analyze WSN over internet and operating systems	H1
CO 5	understand emerging research areas in the field of sensor networks	H2

Course content

Unit 1

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks. Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

Unit II

Routing in sensor networks: Data centric- position based routing- data aggregation- Clustered based routing Algorithms. MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

Unit III

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

Unit IV

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication. Single-node architecture, Hardware components & design constraints, Operating systems and execution environments, introduction to TinyOS and nesC.

Text Books

1. Waltenegus Dargie , Christian Poellabauer, “Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications ,2011
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, Elsevier Publications,2004

Reference Books

1. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
2. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009
3. Anna Hac, “Wireless Sensor Network Designs”, John Wiley & Sons, 2004.

Course Articulation Matrix:

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

SPEECH AND AUDIO PROCESSING
PE/ECE/10-T

Course code: PE/ECE/10-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To Define speech signal modelling	L1
CO 2	To Illustrate the structure of human ear	L2
CO 3	To Apply various speech quantizers	L3
CO 4	To Compare different speech production models	H1
CO 5	To Evaluate filter coefficients	H2

Course Contents

UNIT-1

INTRODUCTION: Speech production and modelling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques – parametric, waveform and hybrid; Requirements of speech codec's –quality, coding delays, robustness, Audio synthesis and Audio effects.

SPEECH SIGNAL PROCESSING: Pitch-period estimation, all-pole and all-zero filters, convolution; Power spectral density, periodogram, autoregressive model, autocorrelation estimation.

UNIT-II

LINEAR PREDICTION OF SPEECH: Basic concepts of linear prediction; Linear Prediction Analysis of non-stationary signals-prediction gain, examples; Levinson-Durbin algorithm; Long term and short-term linear prediction models; Moving average prediction.

UNIT –III

SPEECH QUANTIZATION: Scalar quantization-uniform quantizer, optimum quantizer, logarithmic quantizer, adaptive quantizer, differential quantizers; Vector quantization–distortion measures.

SCALAR QUANTIZATION OF LPC: Spectral distortion measures, Quantization based on reflection coefficient and log area ratio, bit allocation; Line spectral frequency – LPC to LSF conversions, quantization based on LSF.

UNIT-IV

LINEAR PREDICTION CODING: LPC model of speech production; Structures of LPC encoders and decoders; Voicing detection; Limitations of the LPC model.

CODE EXCITED LINEAR PREDICTION: CELP speech production model; Analysis-bysynthesis; Generic CELP encoders and decoders, speech coding standards with example.

TEXT BOOKS:

1. "Digital Processing of Speech Signals", Pearson Education, L.R. Rabiner and R.W. Schafer, Delhi, India, 2004.
2. "Digital Speech", A.M.Kondoz, Second Edition (Wiley Students Edition), 2004.
3. "Speech Coding Algorithms: Foundation and Evolution of Standardized Coders", W.C. Chu, WileyInter science, 2003.

REFERENCE BOOKS:

1. "Discrete-Time Processing of Speech Signals", J. R. Deller, Jr., J. H. L. Hansen and J. G. Proakis, Wiley, IEEE Press, NY, USA, 1999.
2. "Multimedia signal processing", Vaseghi, SaeedV, England John Wiley&Sons 2007

Course Articulation Matrix:

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

WLAN and Security

PE/ECE/11-T

Course code: PE/ECE/11-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Able to describe wireless communication fundamentals.	L1
CO 2	Describe the features and functions of WLAN components.	L2
CO 3	Understand the Wi-Fi communications process and security standards.	L3
CO 4	Analyse and design latest WLAN	H1
CO 5	Able to understand the transmission of data through various networks and solves the various transmission problems.	H2

Course Contents

Unit-I

Fundamentals of Wireless Communication - Fundamentals of Wireless Communication, Advantages, Limitations and Applications, Wireless Media, Infrared Modulation Techniques, DSSS and FHSS, Multiple access technique: TDMA, CDMA, FDMA, CSMA, OFDMA, Frequency Spectrum, Radio and Infrared Frequency Spectrum

Wireless local area networks (WLAN) - Introduction, Types of WLANs, WLAN Equipment, WLAN topologies and Technologies, IEEE 802.11 WLAN: Architecture, Physical Layer Standards.

Unit-II

WLAN Medium access control - Challenges for the MAC, MAC Access Modes and Timing, Contention-Based Access Using the DCF, Fragmentation and Reassembly, Frame Format, Encapsulation of Higher-Layer Protocols Within 802.11, Contention-Based Data Service

Unit-III

WLAN Framing - General frame format, Frame Control field, Format of individual frame types: Control frames, Data frames, Management frames, Types of Management Frames Management Frame fields, Frame Transmission and Association and Authentication States

Unit-IV

Wireless Security - Wireless Application Protocol, WAP Security, Authentication, Integrity, Confidentiality, Security Issues with Wireless Transport Layer Security (WTLS), Wireless LAN Security, Access Point Security, Work Station Security, Safeguarding Wireless LAN's.

Text and Refrences Books:

1. Eldad Perahia and Robert Stacey, Next Generation Wireless LANs: 802.11n and 802.11ac (2nd Edition), Cambridge University Press 2010.
2. Matthew S. Gast, O'Reilly, 802.11 Wireless Networks: The Definitive Guide, 2nd Edition, Media, Inc.1998.
3. Pejman Roshan, Jonathan Leary, 802.11 Wireless LAN Fundamentals, Cisco Press, 2014.
4. Brijendra Singh, Network Security and Management, 3rd edition, PHI 2000.

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

BIO MEDICAL ELECTRONICS
PE/ECE/12-T

Course code: PE/ECE/12-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	To Define about human anatomy and imparting knowledge about types of Bio-electric signals.	L1
CO 2	To Illustrate the machines used for medical diagnosis of illness.	L2
CO 3	To Apply recording systems used for measurement of the bioelectric signals.	L3
CO 4	Introduce about latest technologies.	H1
CO 5	Analyze the biological processes like other electronic processes.	H2

Unit-I

Brief introduction to human physiology, origin of bioelectric signals, basic biomedical instrumentation system, transducers and sensors, displacement, velocity, force, acceleration, flow, temperature, potential, dissolved ions and gases.

Unit -II

Measurement of blood temperature, blood pressure, blood flow, blood pH, pCO_2, pO_2, Bio-electrodes and biomedical recorders, ECG, EMG, EEG, Phono cardiograph

Unit-III

MRI and ultrasonic imaging systems, X-Ray machines, X-Ray computed tomography, Echo-cardiograph. Prostheses and aids, pacemakers, External pacemaker, implantable pacemaker, programmable pacemaker, defibrillators, heartlung machine, artificial kidney.

Unit-IV

Introduction to bio telemetry and its applications in patient care, patient monitoring system, aids for the handicapped, Safety aspects, application in bio-medical field.

Text Books:

1. R.S. Khandpur, Introduction to Bio-Medical Instrumentation, Tata McGraw Hill, New Delhi
2. Crambell, Bio-Medical Instrumentation, Tata McGraw Hill, New Delhi

Reference Books:

1. W.F. Ganong, Review of Medical Physiology, 8th Asian Ed, Medical Publishers, 1977.
2. J.G. Websster, ed., Medical Instrumentation, Houghton Mifflin, 1978.
3. A.M. Cook and J.G. Webster, eds., Therapeutic Medical Devices, Prentice-Hall, 1982

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

Detailed Syllabus
of
B.Tech.(ECE)

Program Elective Course-IV

POWER ELECTRONICS

PE/ECE/13-T

General Course Information:

Course code: PE/ECE/13-T Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 1 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Basics of Electronics

Course Outcomes:

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define the basics operations and characteristics of power electronics devices.	L1
CO 2	To compare the performance of various power semiconductor devices, passive components and switching circuits.	L2
CO 3	To the use of power converters and inverters in commercial and industrial applications.	L3
CO 4	To analyze various single phase and three phase power converter circuits and understand their applications	H1
CO 5	To develop skills to build, and troubleshoot power electronics circuits.	H2
CO 6	To design the SCR controlled devices, firing and commutating circuit, inverters, choppers and drivers.	H3

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.

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: noncirculating and circulating types of cycloconverters.

TEXT BOOK:

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.

REFERENCE BOOKS:

1. Power Electronics: PC Sen; TMH
2. Power Electronics: HC Rai; Galgotia
3. Thyristorised Power Controllers: GK Dubey, PHI

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	3	2	-	1	2	2	1	2	2	1	-
CO2	-	2	2	2	3	2	-	-	-	-	-	-	2	2	2
CO3	3	2	-	-	-	-	-	2	-	2	2	3	2	-	-
CO4	2	-	1	2	-	3	-	1	2	-	1	2	-	1	2
CO5	-	1	2	2	-	2	-	-	-	1	-	-	1	-	-
CO6	2	2	1	-	3	2	-	1	2	2	1	2	2	1	-

Python Programming
PE/ECE/14-T

General Course Information:

Course code: PE/ECE/14-T Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 1 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Exposure to programming languages

Course Outcomes:

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	various basic programming constructs including operators, character sets, basic data types and control statements.	L1
CO 2	Python packages and their functionalities for data analysis.	L2
CO 3	Problems using python programming.	L3
CO 4	The results of data analysis or machine learning programs	H1
CO 5	solutions according to the problem definition	H2
CO 6	Database applications in Python.	H3

Unit I

Introduction : The Programming Cycle for Python, Python IDE, Interacting with Python Programs, Elements of Python, Type Conversion. Basics: Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression.

Unit II

Functions: Parts of A Function, Execution of A Function, Keyword and Default Arguments, Scope Rules. String: Length of the string and perform Concatenation and Repeat operations in it. Indexing and Slicing of Strings. Python Data Structure: Tuples, Unpacking Sequences, Lists, Mutable Sequences, List Comprehension, Sets, Dictionaries Higher Order Functions: Treat functions as first class Objects, Lambda Expressions.

Unit III

Sieve of Eratosthenes : Generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O: File input and output operations in Python Programming Exceptions and Assertions.

Unit IV

Modules and Classes :Modules: Introduction, Importing Modules, Abstract Data Types: Abstract data types and ADT interface in Python Programming. Classes: Class definition and other operations in the classes, Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.), Class Example, Inheritance, Inheritance and OOP.

Text and References Books:

1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist, 2nd edition, Updated for Python 3, Shroff/OReilly Publishers, 2016.
2. Guido van Rossum and Fred L. Drake Jr, An Introduction to Python-Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd.,,2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programsl, CENGAGE Learning, 2012.
7. Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

Course Articulation Matrix:

	PO1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	2
CO2	1	-	-	-	-	3	-	-	-	-	-	-	-	-	3
CO3	3	2	-	2	-	3	-	-	-	-	-	-	-	-	3
CO4	2	3	2	2	-	-	-	-	-	-	-	-	-	-	3
CO5	2	3	2	2	-	-	-	-	-	-	-	-	-	-	3
C06	3	3	2	3	-	3	-	-	-	-	-	-	3	-	3

DIGITAL IMAGE PROCESSING

PE/ECE/15-T

Course code: PE/ECE/15-T Course Credits : 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt other four questions selecting one from each of the four units. All questions carry equal marks.

Pre-requisites: Digital signal processing.

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	Describe general terminology of digital image processing.	L1
CO 2	Explain various types of images, intensity transformations and spatial filtering.	L2
CO 3	Apply Fourier transform for image processing in frequency domain.	L3
CO 4	Compare the methodologies for image segmentation, restoration etc.	H1
CO 5	Select image processing and analysis algorithms for particular application.	H2
CO 6	Develop image processing algorithms for practical applications.	H3

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. Elements of Visual Perception. Light and the Electromagnetic Spectrum. Image Sensing and Acquisition. Image Sampling and Quantization. Some Basic Relationships Between Pixels. Linear and Nonlinear Operations.

IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN : Background. Some Basic Gray

Level Transformations. Histogram Processing. Enhancement Using Arithmetic/Logic Operations. Basics of Spatial Filtering. Smoothing Spatial Filters. Sharpening Spatial Filters.

UNIT-II

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

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

UNIT-III

COLOR IMAGE PROCESSING : Color Fundamentals. Color Models. Pseudocolor Image Processing. Basics of Full-Color Image Processing. Color Transformations. Smoothing and Sharpening. Noise in Color Images.

IMAGE COMPRESSION: Fundamentals. Image Compression Models. Basics of Error-Free Compression and Lossy Compression.

UNIT-IV

IMAGE SEGMENTATION: Detection of Discontinuities. Edge Linking and Boundary Detection. Thresholding. Region-Based Segmentation. Segmentation by Morphological Watersheds.

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

TEXT BOOKS:

1. Digital Image Processing; Gonzalez & Woods, PHI
2. Fundamentals of Digital Image Processing by Anil K Jain, Pearson.
3. Digital Image Processing by William K Pratt,Wiley.

REFERENCE BOOKS:

1. Fourier Methods in Imaging; Roger L. Easton, Wiley
2. Digital Signal Processing; Prokis, Pearson
3. Digital Signal Processing; Salivahanan, McGraw Hills

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	3	2	-	1	2	2	1	2	2	1	-
CO2	-	2	2	2	3	2	-	-	-	-	-	-	2	2	2
CO3	3	2	-	-	-	-	-	2	-	-	-	-	2	-	-
CO4	2	-	1	2	-	3	-	1	2	-	1	2	-	1	2
CO5	-	1	2	2	-	2	-	-	-	1	-	-	1	-	-
CO6	2	2	1	-	3	2	-	1	2	2	1	2	2	1	-

ANTENNA & WAVE PROPAGATION
PE/ECE/16-T

General Course Information:

Course code: PE/ECE/16-T Course Credits : 3 Mode : Lectures (L) Teaching schedule L T P : 3 1 0 Examination Duration : 03 Hours	**Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 are to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt 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
CO 1	To define the basic fundamental concepts of antenna.	L1
CO 2	To understand the various types of antenna in transmission and reception of signals.	L2
CO 3	To use different wave propagation theories in communications.	L3
CO 4	To compare antennas depending upon modes of propagation and their applications.	H1
CO 5	To evaluate the Gain of antenna for various types of applications.	H2
CO 6	To design an antenna for various applications in communication.	H3

Course Contents

UNIT-I

Antenna Radiation: Antenna Parameters: Antenna impedance, Directional patterns, Effective length, Radiation Intensity, Directivity, Power gain, Efficiency, Effective area, Equivalent circuit, Front to back ratio, polarization and antenna temperature, Radiation field, Radiation power, Radiation resistance, Directivity and gain of an alternating current element, half wave dipole , Effect of earth on patterns, Reciprocity Theorem for Antenna and Its Applications.

UNIT-II

Antenna Arrays: 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, log periodic array, Dolph-Techebysheff arrays, binomial array

UNIT-III

Practical Antennas: Top loading and tuning, rhombic antennas, ferrite rod, RUMSEY'S principle, whip antennas, Receiving antennas, horn antenna, microstrip antenna or patch antenna, babinet principle, helical antenna, frequency independent antennas concept , antenna with parabolic reflector.

UNIT-IV

Wave Propagation: Modes of Propagation: Surface Wave Propagation, Sky Wave (Ionospheric) Propagation- Virtual height, Maximum usable Frequency, Skip Distance, Optimum working frequency, Space Wave (Tropospheric) Propagation- line of sight distance.

TEXT BOOKS:

1. Antennas by J.D. Kraus, TMH.
2. Antenna & Wave Propagation by K.D Prasad. Satya Prakashan Publication.
3. Electromagnetic Waves, R.K. Shevgaonkar, Tata McGraw Hill

REFERENCE BOOKS:

1. Antenna & Radiowave Propogation by Collin,TMH.
2. Electromagnetic Waves & Radiating Systems by Jordan & Balman, PHI.
3. Electromagnetic Waves, R.L. Yadav, Khanna Publishing House.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	-	3	2	-	1	2	2	1	2	2	1	-
CO2	-	2	2	2	-	2	-	-	-	-	-	-	2	2	2
CO3	1	2	-	-	-	-	-	2	-	2	2	3	2	-	-
CO4	2	-	1	2	-	-	-	1	2	-	1	2	-	1	2
CO5	-	1	2	2	-	2	-	-	-	1	-	-	1	-	-
CO6	-	2	1	-	3	2	-	1	2	2	1	2	2	1	-

POWER ELECTRONICS LAB
PE/ECE/13-P

General Course Information

Course code: PE/ECE/13-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode : Lab Work	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 Il) 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 Il 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/HOD 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 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/HOD along with the internal assessment marks.

Pre-requisites: Basic Electronics

Sr. No.	Course outcomes At the end of the course, students will be able to:	RBT Level
CO1	To study the VI characteristics of SCR, TRIAC, MOSFET and IGBT.	HOTS: L3
CO2	To analyze the performance of semi converter, full converter, step up, step down choppers by simulation and experimentation.	HOTS: L4
CO3	To study the behavior of voltage waveforms of PWM inverter applying various modulation techniques.	HOTS: L6
CO4	To design and analyze the performance of SMPS.	HOTS:L3
CO5	To study the performance of AC voltage controller by simulation and Experimentation.	HOTS: L6

List of Experiments:

1. To study Characteristics of SCR and TRIAC.
2. To study Characteristics of MOSFET and IGBT.
3. To study AC to DC half controlled converter.
4. To study AC to DC fully controlled converter.
5. Step down and step up MOSFET based choppers.
6. IGBT based single phase PWM inverter.
7. IGBT based three phase PWM inverter.
8. To study AC Voltage controller.
9. TO study Switched mode power converter.
10. Simulation of PE circuits (semi converter, full converter, dc-dc converters, ac voltage controllers).

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

Course Articulation Matrix:

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

Python Programming Lab.

PE/ECE/14-P

General Course Information

Course code: PE/ECE/14-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode : Lab Work	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 Il) 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 Il 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/HOD 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.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/HOD along with the internal assessment marks.

Pre-requisites: Basic programming skills

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	solutions to the given assignments in Python	L3
CO 2	various Python packages for solving different programming problems.	L3
CO 3	solutions for complex problems of data analysis and machine learning.	L6
CO 4	the output of data analysis and machine learning models.	L5
CO5	lab records of the solutions for the given assignments	L6
CO6	use of ethical practices, self-learning and team spirit..	L3

List of experiments

1. Install Python and explore various popular IDE like IDLE, PyCharm, and Anaconda.

2. Assignments to perform various number operations like

a. Find maximum from a list of numbers

b. GCD of two number

c. Square root of a number

d. Check number is prime or not.

e. Print first N prime numbers

f. Remove duplicate numbers from list

g. Print the Fibonacci series.

3. Assignments to perform various operations on Strings like creation, deletion, concatenation.

4. Create a List L = [10, 20, 30]. Write programs to perform following operations:

a. Insert new numbers to list L.

b. Delete numbers from list L.

c. Sum all numbers in list L.

d. Sum all prime numbers in list L.

e. Delete the list L.

5. Create a Dictionary D= {‘Name’: ‘Allen’, ‘Age’: 27, 5:123456}. Write programs to perform following

operations:

a. Insert new entry in D.

b. Delete an entry from D.

c. Check whether a key present in D.

d. Update the value of a key.

e. Clear dictionary D.

6. Two assignments on Sets to perform various operation like union, intersection, difference etc.

7. Two assignments related to searching operation like linear search, binary search.

8. Three assignments related to sorting like selection sort, bubble sort, insertion sort.

9. Demonstrate the use of dictionary for measuring student marks in five subjects and you have to find the student having maximum and minimum average marks.

10. Two assignment on usage of different available packages like random package to perform

a. Print N random numbers ranging from 100 to 500.

b. Print 10 random strings whose length between 3 and 5.

11. Two assignments on usage of package such as Numpy, Pandas.

12. Implement and demonstrate the functions of a simple calculator.

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

Course Articulation Matrix:

	PO1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1	-	-	3	-	-	-	-	-	-	-	-	-	3
CO2	2	3	-	3	3	-	-	-	-	-	-	-	-	-	3
CO3	3	3	1	3	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	-	3	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
C06	-	-	-	-	-	-	-	3	3	-	-	3	-	-	-

DIGITAL IMAGE PROCESSING LAB
PE/ECE/15-P

General Course Information

Course code: PE/ECE/15-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode : Lab Work	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 Il) 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 Il 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/HOD 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 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/HOD along with the internal assessment marks.

Sr. No.	Course outcomes At the end of the course, students will be able to:	RBT Level
CO1	Implement digital image processing concepts for image compression, restoration and reconstruction in SCILAB/MATLAB	HOTS: L3
CO2	Verify the results of applying image processing problems to images (compression, expansion, multi-resolution processing etc.)	HOTS: L4
CO3	Measure the quality of image after the digital image processing techniques are implemented to an image.	HOTS: L5
CO4	Devise solutions for Image Processing tasks problems	HOTS: L6
CO5	Design Lab record for the assignments including aim, hardware and software requirements and solutions to the given problems	HOTS: L6
CO6	Use ethical practices, independent enquiry, self-learning and team spirit	HOTS: L3

List of experiments

1. Two/Three introductory assignments on SCILAB/MATLAB.

2. Two experiment on Point processing and Pixel Operations e.g scan your signature and make it clean with thresholding.)

3. experiment on One Image flipping.

4. experiment on Image Arithmetic such as Addition, subtraction, multiplication and division.

5. Create an application to display "Hello World" string the number of times user inputs a numeric value. (Example. If user enters 5, the next screen should print "Hello World" five times.)

6. experiment on performing Logical operations on Digital images such as NAND, NOR, EX-OR on these images.

7. experiment on calculation and equalization of histogram for an input image.

8. experiment on geometric transformation of image such as translation, Scaling, Rotation, Shrinking, Zooming.

9experiment on adding noise to the image and apply image restoration techniques to improve quality of image.

10. experiment on low pass and high pass filtering in frequency domain.

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

Course Articulation Matrix:

	PO1	**PO 2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	-	3	-	-	-	-	-	-	-	-	-	3
CO2	3	3	2	-	3	-	-	-	-	-	-	-	-	-	3
CO3	3	3	2	-	3	-	-	-	-	-	-	-	-	-	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3
CO5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
C06	-	-	-	-	-	-	-	3	3	-	-	3	-	-	-

ANTENNA AND WAVE PROPAGATION LAB
PE/ECE/16-P

General Course Information

Course code: PE/ECE/16-P Course Credits: 1 Contact Hours: 2/week (L-T-P: 0-0-2) Mode : Lab Work	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 Il) 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/HOD of the Department will only notify the week for the internal laboratory course evaluations. The marks for MLE I and MLE Il 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 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/HOD along with the internal assessment marks.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To define and describe basic antenna parameters like radiation pattern, directivity and gain.	L1
CO 2	To apply basic theorems to analyze the variation of field strengths of radiated waves.	L2
CO 3	To demonstrate the structure and operation of various antennas and describe their performance.	L3
CO 4	To examine performance parameters of uniform linear and planar antenna arrays.	H1
CO 5	To design and implement special type of antennas like microstrip antennas.	H3

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

Note: Atleast eight experiments are to be performed in the semester, out of which minimum six 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.

Course Articulation Matrix:

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

Detailed Syllabus
of
B.Tech.(ECE)
Program Elective Course-V

Introduction to Matlab and Simulink
PE/ECE/17-T

Course code: PE/ECE/17-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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.

S.No.	Course Outcomes: At the end of the lab course a student would be able to:	RBT Level
CO1	Study basic commands and apply programming skills to implement solutions to the given assignments using MATLAB	LOTS:L3 (Apply)
CO2	Analyze and Evaluate the output of various Matrices operation using MATLAB	HOTS:L4 & L5 (Analyse &Evaluate)
CO3	Devise software solutions for common processes of communications systems	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)

UNIT-I

Introduction to MATLAB: Introduction to MATLAB Software: MATLAB Window, Command window, Workspace, Command history, setting directory, basic commands, Assigning variables, operations with variables, Data files and data types: Character and String, Arrays and vectors, Column vectors, Row vectors.

UNIT-II

MATLAB Operations and Plots: Arithmetic operations, Operators and special characters. Mathematical and Logical operators, solving arithmetic equations, Matrix operations: Transpose, determinant and inverse, Trigonometric functions, Complex Numbers, Fractions, Real numbers, M files, Plots: 2D plots, 3D plots, GUI Design.

UNIT-III

MATLAB Simulink: Introduction of Simulink, Simulink environment and Interface, Study of

Library, Circuit oriented design, Equation oriented design, Model, Subsystem Design, Connect call back to subsystem, Application.

UNIT-IV

MATLAB Programming: Control statement programming, Conditional statement programming, Loop and Conditional statements: if, else, switch, for, while, continue, break. User defined functions, Built in Function, Function calling, Return value, Type of functions, Global variables.

TEXT BOOKS:

1. Getting started with MATLAB by Dr. Rudra Pratap, OXFORD University Press.
2. Modeling and Simulation using MATLAB-Simulink by Dr. Shailendra Jain, Dr. Sanjeevan Kapshe, Wiley.
3. MATLAB and Simulink by Dr. Partha S Mallick, Scitech Publications Pvt. Ltd.

REFERENCE BOOKS:

1. Introduction to MATLAB for engineers by William J. Palm.
2. Essential of MATLAB Programming by Stephen J. Chapman.

CO-PO Articulation matrix

List of Course outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO12	PSO 1	PSO 2	PS O3
CO1:Study basic commands and apply programming skills to implement solutions to the given assignments using MATLAB	2	2	2	1	3	1	-	-	-	-	-	-	2	2	2
CO2:Analyze and Evaluate the output of various Matrices operation using MATLAB	2	2	2	3	3	1	-	-	-	-	-	-	2	2	2
CO3:Devise software solutions for common processes of communications systems	3	3	2	3	3	1	-	-	-	-	-	-	2	2	2
CO4: Create written records for the given assignments with problem definition, design of solution and conclusions.	-	-	-	-	-	2	1	3	3	3	3	-	-	-	2
CO5: Demonstrate ethical practices while solving problems individually or in groups.	-	-	-	-	-	2	1	3	3	3	3	-	-	-	2

AI & MACHINE LEARNING

PE/ECE/18-T

Course code: PE/ECE/18-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To learn the difference between optimal reasoning Vs human like reasoning	L3
CO 2	To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities	L3
CO 3	To learn different knowledge representation techniques .	L6
CO 4	To understand the applications of AI namely, Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing.	L5

Unit –I

Foundations of AI and Intelligent Agents: What is AI, History of AI, Strong and weak AI, The State of the Art. Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

Unit –II

Basic AI Concepts and Machine Learning: Boolean Algebra, Expert Systems, Configuration of Device, Introduction to SWI Prolog, Installing prolog, Introduction to Fuzzy Logic, Basic of ML, Colour Selection Algorithm.

Solving Problems by Searching: Problem –Solving Agents, Example Problems, Searching for Solutions, uniformed search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

Unit –III

Knowledge Representation: Ontological Engineering, Categories and Objects, Events, Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information, The Internet Shopping World.

Unit –IV

Learning from Examples: Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, The Theory of Learning, Regression and Classification with Learner Models, Nonparametric Models, Support Vector Machines, Ensemble Learning, Practical Machine Learning.

TEXT BOOKS:

1."Artificial Intelligence A Modern Approach", Stuart J. Russell & Peter Norvig –Pearson.
2."Artificial Intelligence", Elaine Rich, Kevin Knight & Shivashankar B Nair –McGraw Hill Education.
3.Nils J. Nilsson: "Principles of Artificial Intelligence", Elsevier
4. T. Hastie, R. Tibshirani, J. Friedman ---The Elements of Statistical Learning, 2e, 2008.

REFERENCE BOOKS:

1. C. Bishop --- Pattern Recognition and Machine Learning. 2e 2010.
2. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.
3. E. Alpaydin, ―Introduction to Machine Learning (Adaptive Computation and Machine Learning), The MIT Press 2004.
4. S. Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Course Articulation Matrix:

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

CO5	-	1	2	2	-	2	-	-	-	1	-	-	1	-	-

INFORMATION THEORY AND CODING

PE/ECE/19-T

Course code: PE/ECE/19-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Probability theory**.**

Sr. No.	**Course Outcomes** **At the end of the semester, students will be able:**	**RBT** **Level**
CO 1	To describe information theory methods as well as advanced techniques of digital signal processing to communication systems	L1
CO 2	To derive equations for entropy mutual information and channel capacity for all types of channels	L2
CO 3	To apply various source and error control codes and their properties.	L3
CO 4	To compare block codes, convolution codes etc. For error detection and correction.	H1
CO 5	To design various cryptography algorithms & standards.	H3

Course Contents

UNIT-1

INTRODUCTION TO INFORMATION THEORY: Review of Probability Theory, Introduction to Information Theory, Uncertainty and Information, Entropy, Rate of Information, Joint Entropy, Conditional Entropy, Mutual Information, Channels: Noise Free Channel, Binary Symmetric Channel (BSC), Binary Erasure Channel (BEC), Channel Capacity, Shannon's Theorem, Continuous Channel, Capacity of a Gaussian Channel: Shannon-Hartley Theorem, Bandwidth and S/N Trade-off.

UNIT-II

SOURCE CODING: Source Coding Theorem, Shannon- Fano Coding, Huffman Coding, The Lempel-Ziv Algorithm, Lossy Data Compression: Rate Distortion Function, Introduction to Image Compression.

ERROR CONTROL CODING: Introduction to Error Control Coding, Type of Codes, General Description of Basic ARQ Strategies, Hybrid ARQ Schemes.

UNIT –III

LINEAR BLOCK CODES: Linear Block Codes: Properties, Specific Linear Block Codes, Hamming Code, Cyclic Codes, B.C.H Codes, Reed-Solomon Codes, Decoding of Linear Block Codes, Maximum Likelihood Decoding, Error Detecting and Correcting Capabilities of a Block Code.

UNIT-IV

CONVOLUTIONAL CODES: Transfer Function of a Convolutional Code, Viterbi Decoding, Distance Properties of Binary Convolutional Codes, Burst Error Correcting Convolutional Codes.

INFORMATION THEORY AND CRYPTOGRAPHY: Introduction to cryptography, Encryption Techniques, Encryption Algorithms, Symmetric Key Cryptography, Asymmetric Key Algorithms, Data Encryption Standard (DES).

TEXT BOOKS:

1.J G Proakis, "Digital Communications", Tata McGraw Hill, 2001.
2. Ranjan Bose, "ITC and Cryptography", Tata McGraw-Hill.
3. ArijitSaha, Nilotpal Manna, SurajitMandal, "Information Theory, Coding and cryptography", Pearson Education, 2013.
4. N. Abramson, Information and Coding, McGraw Hill, 1963.

REFERENCE BOOKS:

1. Thomas M. Cover, Joy A. Thomas, "Elements of Information Theory", Wiley Publication.
2. R.P. Singh and S.D. Sapre, "Communication System: Analog and Digital", Tata McGraw-Hill.
3. Simon Haykin, "Digital communication", John Wiley.
4. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

Course Articulation Matrix:

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

SATELLITE COMMUNICATION
PE/ECE/20-T

Course code: PE/ECE/20-T Course Credits: 3 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 average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (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: Basics of communication engineering and wave propagation.

Sr. No.	Course Outcomes At the end of the semester, students will be able:	RBT Level
CO 1	To describe the revolving mechanism of satellites.	L1
CO 2	To explain the working principle and operation of satellites.	L2
CO 3	To illustrate the various performance affecting factors.	L3
CO 4	To evaluate the various types of satellite links.	H2
CO 5	To design different satellite links and application systems.	H3

Course Contents

UNIT-1

SATELLITES & MODULATION: Basic block diagram of satellite communication, Satellite frequency allocation & Band spectrum, Advantages of satellite communication, Active & Passive satellites, Analog FM Transmission by Satellite, S/N Ratios for FM Video Transmission, Generation of Quadrature Phase Shift Keying (QPSK) Signals, Transmission of QPSK Signals through a Bandlimited Channel, Signal-to-Noise Ratio in Digital Voice Systems.

UNIT-II

SATELLITE LINK DESIGN: Basic link analysis, Interference analysis, terrestrial interference, System Noise temperature and G/T ratio, G/T ratio for earth stations, Uplink & downlink design, Design for Specified C/N: Combining C/N and C/I Values in Satellite Links, system design examples.

UNIT –III

ORBITAL MECHANISM & MULTIPLEXING: Satellite orbit and orbital equations, Kepler's laws of planetary motion, Look angle calculation, coverage angle and slant range, orbital perturbations, Orbital Elements, Apogee and Perigee Heights. TDMA, TDMA-Frame structure, Multiple Beam (Satellite switched) TDMA satellite system, Beam Hopping (Transponder Hopping) TDMA, TDMA compared to FDMA, CDMA & hybrid access techniques.

UNIT-IV

SATELLITE BASED NAVIGATION SYSTEM: Basic principles of satellite navigation, Signal travel time, Determining position, functional segments of GPS, Improved GPS: DGPS, SBAS, A-GPS and HSGPS.

TEXT BOOKS:

1. Tri, T.Ha, "Digital Satellite Communications, " (Second Edition) Tata McGraw Hill.
2. Timothy Pratt, Jeremy E., "Satellite Communications," Willey.
3. G S Rao, "Global Navigation Satellite Systems," Tata McGraw Hill.

REFERENCE BOOKS:

1. D. Roddy, Satellite Communication (4/e), McGraw- Hill, 2009. 2. B.N. Agrawal, Design of Geosynchrons Spacecraft, Prentice- Hall,1986.

Course Articulation Matrix:

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

LIST OF OPEN ELECTIVES(OE) COURSES TO BE OFFERED BY ECE BRANCH/ DEPARTMENT TO THE STUDENTS OF OTHER BRANCH/ DEPARTMENT

Open Elective Course-I for B.Tech. 5th Semester by ECE deptt.

Sr. No.	Course Code	Course Nomenclature	Offered By	Credits
1.	OE/ECE/1-T	Principles of Digital Electronics	Electronics & Communication Engineering	3
	OE/ECE/2-T	Basics of Electronics Engineering		
	OE/ECE/3-T	Electronic Measurements & Instrumentation		

Open Elective Course-II for B.Tech. 6th Semester by ECE deptt.

Sr. No.	Course Code	Course Nomenclature	Offered By	Credits
1.	OE/ECE/4-T	Fundamentals of Communication Systems	Electronics & Communication Engineering	3
	OE/ECE/5-T	Bio-medical electronics		
	OE/ECE/6-T	8051 Microcontroller		

Open Elective Course-III for B.Tech. 7th Semester

Sr. No.	Course Code	Course Nomenclature	Offered By	Credits
1.	OE/ECE/7-T	Introduction to MATLAB and SimuLink	Electronics & Communication Engineering	3
	OE/ECE/8-T	Introduction to 5G/6G Technology		
	OE/ECE/9-T	Consumer & industrial Electronics		

Detailed Syllabus
of
B. Tech. (ECE)
V Semester
Open Elective Course-I

PRINCIPLES OF DIGITAL ELECTRONICS

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/1-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able to:	RBT Level
CO 1	Define the fundamental concepts and techniques used in digital electronics.	L1
CO 2	Understand the minimization techniques to simplify the hardware requirements of digital circuits, implement it, design and apply for real time digital systems.	L2
CO 3	Demonstrate the working mechanism and design guidelines of different combinational, sequential circuits & logic families and their role in the digital system design.	L3
CO 4	Develop the nomenclature and technology in the area of memory devices and apply the memory devices in different types of digital circuits for real world application.	H3

Course Content

UNIT-I

DIGITAL FUNDAMENTALS: Number Systems– Decimal, Binary, Octal, Hexadecimal, 1's and2's complements, Codes–Binary, BCD, Excess3, Gray, Alphanumeric codes, Boolean theorems. Logic gates: Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh lap, Minimization and Quine-McCluskey method of minimization.

UNIT-II

COMBINATIONAL CIRCUIT DESIGN: Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder– Carry look ahead Adder, BCD-Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder

UNIT-III

SYNCHRONOUS SEQUENTIAL CIRCUITS: Flipflops –SR, JK, T, D, Master/Slave FF –operation and excitation tables, Triggering OFF, conversion of FF. Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT-IV

MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS: Basic memory structure – ROM, PROM, EPROM, EEPROM, EAPROM, RAM, Static and dynamic RAM. Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Field Programmable Gate Arrays (FPGA). Digital Logic Families: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, RTL, TTL, ECL, CMOS.

Text Books:

1. Modern Digital Electronics (Edition III): R.P. Jain; TMH
2. Digital Fundamentals :Thomas L Floyd
3. Digital circuits and design: S. Salivahanan, and S. Arivazhagan

Reference Books:

1. Digital Integrated Electronics: Taub & Schilling; MGH
2. Digital Principles and Applications: Malvina & Leach; McGraw Hill.
3. Digital Design: Morris Mano; PHI.

Course Articulation Matrix:

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

BASICS OF ELECTRONICS ENGINEERING

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/2-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able to:	RBT Level
CO 1	Students will be able to define the behavior of semiconductor devices.	L1
CO 2	Students will be able to describe the current flow of a bipolar transistor in CB, CE and CC configurations.	L2
CO 3	Students will be able to illustrate the biasing of transistors and FETs for amplifier applications.	L3
CO 4	Students will be able to examine simple amplifier and oscillator circuits.	L4
CO 5	Students will be able to solve the practical problems using the basic knowledge gained on electronic systems.	L5

Course Contents

UNIT-I

Semi-Conductors and Diodes: Introduction, Insulators, semiconductors and metals, Mobility and conductivity, Intrinsic and extrinsic semiconductors, Charge density, current components in

semiconductors, PN junction diode- Characteristics and analysis, Types of diodes- Zener, Photodiodes, LED. Rectifiers: Half wave rectifier, Full wave rectifier, bridge rectifier and their analysis, Series and shunt diode clippers, Clamping operation, Clamping circuit, Basic regulator supply using zener diode.

UNIT-II

Transistors: Construction and characteristics of BJT, Transistor configuration: CB, CE, CC configuration, Transistor at low frequency, Transistor biasing and bias stabilization: Operating point, Stability factor, Analysis of fixed bias, collector to base bias, Emitter resistance bias circuit and self bias circuit.

UNIT-III

Field Effect Transistor: Construction and characteristics of JFET, JFET biasing circuit, JFET amplifier, MOSFET construction and characteristics.

UNIT-IV

Amplifiers and Oscillators: Classification of amplifiers, concept of feedback, Characteristics of feedback amplifiers, Single stage RC coupled amplifier, Oscillators, Criterion for oscillation, Types of oscillators: Hartley oscillator, Colpitt oscillator, RC-phase shift oscillator, Wein bridge oscillator

Text and Reference Books

1. Integrated devices & Circuits by Millman & Halkias, McGraw Hill.

2. Electronics Devices and Circuit Theory by Robert L. Boylestad, Pearson.

3. Electronics Devices and Circuits-II by A.P.Godre & U.A. Bakshi.

4. Electronics Devices and Circuit by G.K. Mithal.

Course Articulation Matrix:

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

ELECTRONIC MEASUREMENTS & INSTRUMENTATION

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/3-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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: Knowledge of basic electronic components.

Sr. No.	Course Outcomes At the end of the semester, students will be able to:	RBT Level
CO 1	Define the fundamental concepts and techniques used in electronic measurements and instrumentation.	L1
CO 2	Understand and explain construction and working of various measuring instruments.	L2
CO 3	Execute the knowledge of waveform generators, waveform analyzers, transducers.	L3
CO 4	Compare and categorize waveform generators, waveform analyzers, transducers.	H1

Course Contents

UNIT-1

INTRODUCTION: Introduction of Measurement, Classification of Measurement Errors, Instrument Accuracy, accuracy & Precision, Resolution, Significant Figures, Analog Multimeter, digital Multimeter, digital Frequency meter, Digital measurement of time, Digital measurement of frequency(Mains), Digital t achometer, Digital pH meter,Q meter

UNIT-II

OSCILLOSCOPES: Block Diagram based Study of CRO, vertical amplifier, Horizontal Deflecting System, Role of Delay Line, Typical CRT connections, Dual-Trace CROs,

Measurement using Oscilloscope-Measurement of Voltage, Frequency, Phase Difference, Rise Time, Fall Time, Lissajous Figures in Detection of Frequency and Phase, Digital Storage Oscilloscope (DSO), Applications of DSO.

UNIT –III

GENERATION & ANALYSIS OF WAVEFORMS: Low frequency Signal Generators, function generators, pulse generators, R.F signal generators, Sweep frequency generators,frequency synthesizer, Basic wave analyzer, Frequency selective wave analyzer, heterodyne wave analyzer, harmonic distortion analyzers, spectrum analyzer.

UNIT-IV

TRANSDUCERS: Introduction, Electrical transducer, Selection Criteria of Transducers, Transducers types: Resistive transducer, Inductive transducer, capacitive transducer, Thermal transducer, optoelectronic transducer, Piezoelectric transducers. Introduction to Analog and Digital Data Acquisition Systems and Telemetry.

TEXT BOOKS:

1. Electronic Instrumentation and Measurements : David A Bell; Oxford
2. Electronic Instrumentation : H.S.Kalsi ;TMH,2ndEdition
3. A course in Electrical & Electronics Measurements & Instrumentation : A.K.Sawhney; Dhanpat Rai .

REFERENCE BOOKS:

1. Electronic Instrumentation And Measuring Techniques: W.D. Cooper; PHI
2. Modern Electronic Instrumentation & Measuring Techniques: Helfrick & Copper ; PHI
3. Measurement Systems: E.O.doebilin ; McGraw Hill

Course Articulation Matrix:

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

Detailed Syllabus
of
B. Tech. (ECE)
VI Semester
Open Elective Course-II

FUNDAMENTALS OF COMMUNICATION SYSTEMS

(Students from Department of ECE Engineering cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/4-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able:	RBT Level
CO 1	To describe the basic principles of communication system.	L1
CO 2	To explain the generation & detection of modulated signals.	L2
CO 3	To evaluate the performance of signal under effects of noise.	H1
CO 4	To examine information signals against various impairments & limitations.	H2

Course Contents

UNIT-1

Introduction: Introduction to Communication System, Terminologies for Communications Systems, Electromagnetic spectrum and typical application, concept of electrical communication, modes and media of Communication, Elements of analog Communication system, Need for modulation.

UNIT-1I

Amplitude Modulation: Theory of AM, mathematical expression, waveforms, modulation index, types of AM; Generation of AM: Square law modulation, Switching modulator, Balanced modulator.

UNIT-III

Frequency Modulation: Theory of FM, mathematical expression, waveforms, modulation index;, Narrow band and Wide band FM, Comparison between AM and FM; Generation of FM: Direct Methods–Varactor diode modulator; Indirect method-Armstrong FM system.

UNIT-IV

Digital modulation techniques: Sampling theorem, ASK, FSK, PSK techniques theory, mathematical expressions and Block diagram of generation and degeneration.

Text Books:

1. R.P. Singh, S.D. Sapre, "Communication Systems: Analog and Digital", 3rd Edition, McGraw Hill.

2. George Kennedy, Bernard Davis &SR.Prasanna, "Electronic Communication Systems, 5th Edition, McGraw Hill.

3. H.Taub, D.L. Schilling & G.Saha, "Principles of Communication Systems", 4th edition, McGraw Hill.

Reference Books:

1. Couch: Digital and Analog Communication Systems,6th Edition, Pearson Education.

2. Bernard Sklar: Digital Communication,2nd Edition, Pearson Education.

3. Digital Communications by John G. Proakis; McGraw Hill.

Course Articulation Matrix:

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

Bio-medical electronics

(Students from Department of ECE Engineering cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/5-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able:	RBT Level
CO 1	Understand the basic medical instrumentation system and bioelectric potentials	L1
CO 2	Illustrate different types of electrodes to acquire bio-signals.	L2
CO 3	Demonstrate clinical laboratory measurements and assistive devices.	H1
CO 4	Discuss about the latest developments in medical imaging systems.	H2

Course Contents

UNIT-I

Components of Medical Instrumentation Systems: Basic Medical Instrumentation System, Static and dynamic characteristics of medical instruments, Bio-signals and characteristics. Problems encountered with measurements from human beings. Sources of Bioelectric Potentials, Resting and Action Potentials

UNIT-II

Bio-Potential Electrodes and Physiological Transducers:

Electrode potential and its equivalent circuit, Types of Electrodes-Surface Electrodes, Needle Electrodes, Micro Electrodes. Biochemical Transducers.

Bio-Signal Acquisition: Electrical Conduction system of the heart, Electrocardiogram, ECG leads, Einthoven triangle, Plethysmography, EEG 10-20 lead system and EMG.

UNIT-III

Clinical laboratory Measurements: Blood cell Counter, Blood flow meters- Electromagnetic blood flow meter, Ultrasonic Doppler blood flow meter, automated blood pressure measurements.

Physiological Assist Devices & Therapeutic Equipment: Pacemakers -External & internal, Defibrillators- External & internal, Hemodialysis machine

UNIT-IV

Monitory and Imaging Equipment: Spirometry, Ventilators, Arrhythmia Monitor, Foetal Monitor and Incubator. X-ray machine,Computed Tomography (CT), Magnetic Resonance Imaging System, Ultrasound Imaging system

Text Books:

1. Leslie Cromwell, F.J. Weibell, E.A. Pfeiffer, Biomedical Instrumentation and Measurements. 2nd Edition, PHI, 2004.

2. Dr. M. Arumugam, Biomedical Instrumentation. 2nd Edition, Anuradha publications, 2002.

References:

1. R.S. Khandpur, Hand-book of Biomedical Instrumentation. 2nd Edition, TMH, 2003.

2. John G. Webster, Medical Instrumentation, Application and Design. John Wiley, 3rd Edition, 2009.

3. Onkar N. Pandey, Rakesh Kumar, Bio-Medical Electronics and Instrumentation. 3rdEdition, Katson Books, 2002.

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

8051 Microcontroller

(Students from Department of ECE Engineering cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/6-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able to:	RBT Level
CO 1	Describe the evolution of processor architectures.	L1
CO 2	Describe the instruction set of Microcontroller.	L2
CO 3	Apply instruction set in writing assembly language programs.	L3
CO 4	Evaluate the performance of timers and counters in real-time response.	H1
CO 5	Design an Embedded System for various applications.	H2

Course Contents
UNIT I

Microcontroller 8051 - Building Blocks: Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

UNIT-II

Microcontroller 8051 - Programming: Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

UNIT-III

Microcontroller 8051 - Interfacing: Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

UNIT-IV

Microcontroller Types: RISC Microcontrollers, introduction to AVR series microcontrollers. Introduction to ARM7 microcontroller (LPC2148).

Text Books:

1. R S Gaonkar, *Microprocessor Architecture, Programming and Application with 8085*, Penram International Publishing Pvt. Ltd.

2. Kenneth Ayala, *The 8051 Microcontroller*, Cengage Learning

3. Douglas Hall, *Microprocessors Interfacing*, Tata McGraw Hill

Reference Books:

4. Subrata Ghoshal, *8051 Microcontroller: Internals, Instructions, Programming and Interfacing*, Pearson Education

5. K Uma Rao, Andhe Pallavi, *The 8051 Microcontrollers: Architecture, Programming and Applications,* Pearson Education.

Course Articulation Matrix:

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

Detailed Syllabus
of
B. Tech. (ECE)
VII Semester
Open Elective Course-III

INTRODUCTION TO MATLAB AND SIMULINK

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/7-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able:	RBT Level
CO 1	To understand the basic operations of signal processing & Commands using MATLAB.	L2
CO 2	To demonstrate various operations and plots using MATLAB.	L3
CO 3	To understand simulink and library	H1
CO 4	To design programs using various functions	H2

Course Contents

UNIT I

Introduction to MATLAB: Introduction to MATLAB software, MA.TLAB Window, Command window, Workspace, Command history, setting directory, basic commands, Assigning variables, operations with variables, Data files and data types: Character and String, Arrays and vectors, Column vectors, Row vectors

UNIT-II

MATLAB operations and Plots: Arithmetic operations, Operators and special characters, Mathematical and Logical operators, solving arithmetic equations, Matrix operations: Transpose, determinant and inverse, Trigonometric functions, Complex Numbers, Fractions, Real numbers, M files, Plots: 2D plots, 3D plots, GUI Design.

UNIT-III

MATLAB Simulink: Introduction of Simulink, Simulink environment and Interface, Study of Library, Circuit oriented design, Equation oriented design, Model, Subsystem Design, Connect call back to subsystem, Application.

UNIT-IV

MATLAB Programming: Control statement programming, Conditional statement programming, Loop and Conditional statements: if, else, switch, for, while, continue, break. User defined functions, Built in Function, Function calling, Return value, Type of functions, Global variables.

Text Books:

1. Getting started with MATLAB by Dr. Rudra Pratap, OXFORD University Press.
2. Modeling and Simulation using MATLAB-Simulink by Dr. Shailendra Jain, Dr. Sanjeevan Kapshe, Wiley.
3. MATLAB and Simulink by Dr. Partha S Mallick, SciTech Publications Pvt. Ltd

Reference Books:

1. Introduction to MATLAB for engineers by William J. Palm.
2. Essential of MATLAB Programming by Stephen J. Chapman.

Course Articulation Matrix:

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

INTRODUCTION TO 5G/6G TECHNOLGY

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/8-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able:	RBT Level
CO 1	Define the significance of communication in daily life	L1
CO 2	Explain the evolution of Mobile Communication and technologies over the years	L2
CO 3	Use the theory of communication in different scenario	L3
CO 4	Compare the speed of LTE and 5G/6G in cellular communication	L4
CO 5	Evaluate various types of application of 5G/6G and advanced techniques in cellular communications.	L5

Course Contents

UNIT I

Evolution from 1G to 5G, LTE features and architecture, introduction to 5G communication, architecture, New Radio, massive MIMO, Potentials AND applications of 5G, usuage scenarios, Spectrum for 5G, 5G deployment, challenges and Applications

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 plain Protocols, Control Plain Protocols, Network Slicing, RAN Virtualization

UNIT IV

6G Currents research & initiatives, 6G Opportunities & applications, 6G networks, 6G challenges.

Course Articulation Matrix:

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

CONSUMER & INDUSTRIAL ELECTRONICS

(Students from Department of ECE cannot opt this subject as Open Elective)

General Course Information:

Course Code: **OE/ECE/9-T** Course Credits: 3 Mode: Lecture (L) Type: Open Elective Teaching Schedule L T P: 3 0 0 Examination Duration: 03 hours.	**Course Assessment Methods; Max. Marks: 100 (Internal: 30; External: 70)** **Course Assessment Methods (Internal: 30; External: 70)** Three minor tests each of 20 marks will be conducted. The average of the highest marks obtained by a student in the any of the two minor examinations will be considered., Class Performance measured through percentage of lectures attended (4 marks), assignments, quiz etc. (6 marks), and the end- semester examination (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 7 short answers type questions, Rest of the eight question 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 the end of the semester, students will be able:	RBT Level
CO 1	Name different types of Audio/Video devices	L1
CO 2	Explain the devices on component level.	L2
CO 3	Illustrate state of the art technology in consumer items	L3
CO 4	Examine proper transducer and other constituent components on the basis of particular application.	H1
CO 5	Judge the faults in consumer electronic items	H2
CO 6	Develop the idea of troubleshooting in consumer electronics items	H3

Course Contents

UNIT-1

AUDIO SYSTEMS: Basic characteristics of sound signal: level and loudness, pitch, frequency response, fidelity and linearity, Reverberation; Audio level metering, decibel level in acoustic measurement; Loud speaker: working principle, Types: electrostatic, dynamic,permanent magnet etc , Audio system: CD player, home theatre sound system, surround sound; Digital console: block diagram, working principle, applications

UNIT-II

VIDEO SYSTEMS: Basic block diagram and working of the following: Digital TVs, LCD, LED, PLASMA, HDTV, 3-D TV, projection TV, DTH receiver; Video interface: Composite, Component, Separate Video, Digital Video, SDI, HDMI Multimedia Interface), Digital Video Interface; CD and DVD player: working principles, interfaces; Touch screen

UNIT –III

OFFICE GADGETS: Basic block diagram and working of the following: Desktop computer, Mouse, Keyboard, Laptop, Digital Storage Devices; Printer (inkjet, laser and 3D), Scanner, FAX machine, Photocopier, EPABX, Online and Offline UPS, LCD Projector, Bar Coding Machine

UNIT-IV

HOME GADGETS: Basic block diagram and working of the following: Air Conditioner, Digital Camera/ Camcoder, Refrigerator, Microwave Oven, Mobile Phone Handset, Mobile Charger, RO system, Inverter, Home security and CCTV.

TEXT 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 Press

REFERENCE BOOKS:

1. W. Jerry and B. Blair, "Standard Handbook of Audio Engineering", Mc Graw Hill Professional
2. Millman, "Integrated Circuits", Tata Mc Graw Hill Publishers
3. Boylsted, "Electronic Devices and Circuit Theory", Pearson

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	-	**2**	-	**1**	**2**	**1**	-	**2**	-	**1**	-
CO2	**3**	**3**	**2**	**1**	**1**	**2**	-	**1**	**2**	**2**	-	**2**	-	-	**2**
CO3	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	-	1	-	-	**2**
CO4	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**2**	**2**	**3**	-	**3**	**2**	**2**	-
CO5	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	-	**3**	**1**	-	-
CO6	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**3**	-	**3**	-	-	1