SYLLABUS

FOR

B.TECH. PROGRAMME

IN

ELECTRONICS & COMMUNICATION ENGINEERING

(3^{rd} to 8^{th} Semester)

UNIVERSITY OF KASHMIR

SRINAGAR

NOVEMBER – 2021

(Applicable to Batch 2020 & Onwards)

Abdul Mueed Hafiz

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Course Structure, B.Tech Electronics and Communication Engineering

3rd Semester to 8th Semester

Code	*Description*	*Code*	*Description*	*Code*	*Description*
ESC	Engineering Science Courses	**PCC**	Professional Core Course	**MSA**	Mid Semester Assessment
BSC	Basic Science Courses	**PEC**	Professional Elective Course	**MSE**	Mid Semester Evaluation
OEC	Open Elective Course	**ESE**	End Semester Evaluation	**IA**	Internal Assessment (Assignment + Quiz + Attendance)

Semester - 3 (Three)	**Examination Scheme (Distribution of Marks)**

Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
BSCMTH31	Engineering Mathematics – III	2	1	0	3	35	15	50	100
PCCECE32	Network Analysis and Synthesis	3	1	0	4	35	15	50	100
PCCECE33	Analog Electronic Circuits – I	2	1	0	3	35	15	50	100
PCCECE34	Digital System Design – I	2	1	0	3	35	15	50	100
ESCECE35	Data Structures	2	1	0	3	35	15	50	100
PCCECE32L	Network Analysis and Synthesis Lab	0	0	2	1	50		50	100
PCCECE33L	Analog Electronic Circuits Lab – I	0	0	2	1	50		50	100
PCCECE34L	Digital System Design Lab – I	0	0	2	1	50		50	100
ESCECE35L	Data Structures Lab	0	0	2	1	50		50	100
PCCECE36L	EDA Tools Lab – I	0	0	2	1	50		50	100
Total Hours		**11**	**5**	**10**	**21**				**1000**
		26							

Semester - 4 (Four)					Examination Scheme (Distribution of Marks)				
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
BSCMTH41	Engineering Mathematics – IV	2	1	0	3	35	15	50	100
PCCECE42	Analog Electronic Circuits – II	2	1	0	3	35	15	50	100
PCCECE43	Digital System Design – II	2	1	0	3	35	15	50	100
PCCECE44	Signals and Systems	2	1	0	3	35	15	50	100
PCCECE45	Electromagnetic Fields and Waves	2	1	0	3	35	15	50	100
ESCECE46	OOPS with Java	2	0	2	3	35	15	50	100
PCCECE42L	Analog Electronic Circuits Lab – II	0	0	2	1	50		50	100
PCCECE43L	Digital System Design Lab – II	0	0	2	1	50		50	100
PCCECE44L	Signals and Systems Lab	0	0	2	1	50		50	100
PCCECE46L	EDA Tools Lab – II	0	0	2	1	50		50	100
Total Hours		**12**	**5**	**10**	**22**				**1000**
		27							

Semester - 5 (Five)					Examination Scheme (Distribution of Marks)				
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
PCCECE51	Information Theory and Coding	2	1	0	3	35	15	50	100
ESCECE52	Digital Signal Processing	2	1	0	3	35	15	50	100
PCCECE53	Communication Systems – I	3	1	0	4	35	15	50	100
PCCECE54	Microprocessors	2	1	0	3	35	15	50	100
PCCECE55	Control Systems	2	1	0	3	35	15	50	100
ESCECE52L	Digital Signal Processing Lab	0	0	2	1	50		50	100
PCCECE53L	Communication Systems Lab – I	0	0	2	1	50		50	100
PCCECE54L	Microprocessors Lab	0	0	2	1	50		50	100
PCCECE55L	Control Systems Lab	0	0	2	1	50		50	100
PCCECE56L	EDA Tools Lab – III	0	0	2	1	50		50	100
Total Hours		**11**	**5**	**10**	**21**				**1000**
		26							

Semester - 6 (Six)					Examination Scheme (Distribution of Marks)				
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
PCCECE61	Communication Systems – II	3	1	0	4	35	15	50	100
PCCECE62	Microcontrollers and Embedded Systems	2	1	0	3	35	15	50	100
PCCECE63	Electrical Machines	2	1	0	3	35	15	50	100
PCCECE64	Electronic Measurement & Instrumentation	2	1	0	3	35	15	50	100
PCCECE65	VLSI Design	2	1	0	3	35	15	50	100
PEC1ECE6**E	Professional Elective – I	2	1	0	3	35	15	50	100
PCCECE61L	Communication Systems Lab – II	0	0	2	1	50		50	100
PCCECE62L	Microcontrollers and Embedded Systems Lab	0	0	2	1	50		50	100
PCCECE64L	Electronic Measurement & Instrumentation Lab	0	0	2	1	50		50	100
PCCECE65L	VLSI Design Lab	0	0	2	1	50		50	100
PSIECE66	Seminar	0	0	2	1				100
Total Hours		**13**	**6**	**10**	**24**				**1100**
		29							

Semester - 7 (Seven)					Examination Scheme (Distribution of Marks)				
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
ESCECE71	Power Electronics	2	1	0	3	35	15	50	100
PCCECE72	Data Communication	2	1	0	3	35	15	50	100
PCCECE73	Microwave Engineering	3	1	0	4	35	15	50	100
PCCECE74	Computer Organization and Architecture	2	1	0	3	35	15	50	100
PEC2ECE7**E	Professional Elective – II	2	1	0	3	35	15	50	100
ESCECE71L	Power Electronics Lab	0	0	2	1	50		50	100
PCCECE72L	Data Communication Lab	0	0	2	1	50		50	100
PCCECE73L	Microwave Engineering Lab	0	0	2	1	50		50	100
PEC2ECE7**E	Professional Elective Lab – II	0	0	2	1	50		50	100
PSIECE76	Project (Phase-I)	0	0	2	1				100
Total Hours		**11**	**5**	**10**	**21**				**1000**
		26							

Semester - 8 (Eight)					Examination Scheme (Distribution of Marks)				
Course Code	**Course Title**	**L**	**T**	**P**	**Credits**	**MSA**		**ESE**	**Total**
						MSE	**IA**		
PCCECE81	Wireless Communication	2	1	0	3	35	15	50	100
PCCECE82	Computer Network & Security	2	1	0	3	35	15	50	100
BSCECE83	Organization of Engineering Systems & HR Management	2	1	0	3	35	15	50	100
OECECE8**E	Open Elective	2	1	0	3	35	15	50	100
PCCECE81L	Wireless Communication Lab	0	0	2	1	50		50	100
PCCECE82L	Computer Network & Security Lab	0	0	2	1	50		100	100
OECECE8**E	Open Elective Lab	0	0	2	1	50		50	100
PSIECE84	Project (Phase-II)	-	0	8	4	50		50	100
PSIECE85	Professional Viva	-	-	0	1	50		50	100
PSIECE86	Industrial Internship	0	0	0	1	50		50	100
Total Hours		**8**	**4**	**14**	**<u>21</u>**				1000
		27							

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List of Electives

(** is as per **S. No**.)

S. No.	Professional Elective Course - I (PEC1ECE6**E)
01	Solid-state Devices
02	Advanced Embedded systems Prototyping
03	Advanced Microprocessors
04	Power Systems
05	System Design
06	Mathematics for Machine Learning
07	Operations Research
S. No.	**Professional Elective Course -II (PEC2ECE7**E)**
01	Introduction to Machine Learning
02	Introduction to Machine Learning Lab
03	Digital Image Processing
04	Digital Image Processing Lab
05	Optical Communication Systems
06	Optical Communication Systems Lab
07	RF Circuit Design
08	RF Circuit Design Lab
09	Computer Architecture and Parallel Processing
10	Computer Architecture and Parallel Processing Lab
11	Network Security and Cryptography
12	Network Security and Cryptography Lab
13	Mixed Signal Design
14	Mixed Signal Design Lab
15	Antenna Design
16	Antenna Design Lab
S. No.	**Open Elective Course (OECECE8**E)**
01	Internet of Things
02	Internet of Things Lab
03	Sensors and Actuators for IOT
04	Sensors and Actuators for IOT Lab
05	Deep Learning
06	Deep Learning Lab
07	Industrial IOT
08	Industrial IOT Lab
09	Robotics Engineering
10	Robotics Engineering Lab
11	Mechatronics
12	Mechatronics Lab
13	Microprocessors in Automation
14	Microprocessors in Automation Lab

3rd Semester

Course No.	Subject	Teaching Periods		Credits
		L	T	
BSCMTH31	**Engineering Mathematics - III**	2	1	3

Section	Course contents	Hours
1.	Laplace transform, shifting theorem	4
2.	Laplace transform of differential functions	4
3.	Heaviside's unit step function	2
4.	Dirac-delta function and its Laplace transform	2
5.	Heaviside's expansion theorem	2
6.	Inverse Laplace transform	4
7.	Initial and final value theorem	3
8.	Convolution theorem	1
9.	Applications of Laplace transform in the solution of linear differential equations	4
10.	Fourier series, Harmonic Analysis	4
11.	Definition of Fourier transform, Fourier sine and Cosine Transform	3
12.	Fourier integral formula	4
13.	Applications to solutions of BVP	4
14.	Data modeling , types, tools and techniques	4
15.	Data interpretation , types methods and tools	5
	TOTAL HOURS FOR THE COURSE	**50**

References

1. Laplace Transforms by Murray R. Speigal
2. Advanced Engg. Mathematics: Erwin Kreyzing- Wiley Eastern. Pub.
3. Higher Engg. Mathematics: B.S. Grewal - Khanna publishers.
4. Advanced Engineering Mathematics: Michael D Greenberg-PHI.
5. Higher engineering mathematics: H. K. Dass, Rajnish Verma-S. Chand

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE32	**Network Analysis and Synthesis**	3	1	4

Section	Course contents	Hours
1	Charge and energy, capacitance, inductance and resistance parameters in the light of field and circuit concepts	3
2	Approximate realization of a physical system as a circuit. Reference directions for currents and voltages, conventions for magnetically coupled circuits, Circuit topology	4
3	First order differential equation: Differential equations as applied in solving networks. Application of initial conditions. Evaluating initial conditions in networks	6
4	Laplace Transformations. Wave form analysis and Synthesis; The unit step, ramp and impulse functions and Laplace transforms. Initial and final value theorem, Convolution integral, convolution as summation	6
5	Network theorems and impedance functions: Complex frequency, transformer impedance and transform circuits, series and parallel combination of elements	5
6	Network Functions – Poles and Zones: Ports of terminal pairs. Network functions for one port and two port network. Time domain behavior from poles zero plot	5
7	Two port parameters: Relationship between two-port parameters. Admittance, Impedance, transmission and hybrid parameters	6
8	Relationship between parameter sets. Parallel connection of two port Networks. Characteristic impedance of two port networks	5
9	Filters Filter fundamentals - pass & stop band, filter classification	5
10	Constant-k and m-derived Filters	5
TOTAL HOURS FOR THE COURSE		**50**

References

1. Network Analysis by Van Valkenberg
2. Network Analysis & Synthesis by F. Kuo
3. Network Analysis by G.K.Mittal

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE33	**Analog Electronic Circuits - I**	2	1	3

Section	Course contents	Hours
1	***P-N Junction diode*****:** Brief review of structure and operation, **c**urrent components in a p-n junction, Circuit models	6
2	Temperature dependence, Diode capacitances and switching times, rectifier circuits, voltage regulation, limiting circuits, level shifters, voltage multipliers	4
3	***BJT*****:** Brief review of structure and operation, IV characteristics, Equivalent circuit models, Ebers-Moll model, CE, CC and CB configurations, input and output characteristics, Biasing and bias stability, analysis of basic amplifier configurations	8
4	Low frequency h-parameter model, Analysis and design of transistor amplifiers using h-parameters. Millers theorem	4
5	High frequency hybrid-pi model, Analysis and design of transistor amplifier circuits at high frequencies. Multistage amplifiers, phototransistors, transistor as a switch	5
6	***FET*****:** Brief review of structure, operation and characteristics of JFET and MOSFET, Depletion and enhancement type MOSFETS, FET biasing	4
7	FET Small signal model, Common source, Common drain and Common gate amplifiers and their analysis. Low and High frequency response of FET amplifier	5
8	***Building Blocks of IC Amplifiers*****:** Current sources, current mirrors and current steering circuits, CE and CS amplifiers with current source loads	4
9	Cascode amplifier, folded cascode, double cascoding, Wilson current mirror, Wildar current source, Darlington pair	4
10	***Feedback Basics*****:** General feedback structure, impact of positive and negative feedback on circuit parameters, feedback topologies (series-shunt, series-series, shunt-series, shunt-shunt), Analysis of example circuits for each feedback topology, stability in feedback amplifiers	8
TOTAL HOURS FOR THE COURSE		**52**

References

1. Sedra A.S. and Smith K.C., Microelectronic Circuits, *Oxford University Press.*
2. Razavi B., Fundamentals of Microelectronics, *John Wiley & Sons.*
3. Boylestad R. and Nashelsky L., Electronic Devices and Circuits, *Prentice Hall*
4. J. Millman and C. Halkias, Integrated Electronics, *McGraw Hill Publications*
5. Neamen D. A., Microelectronics: Circuit Analysis and Design, *McGraw Hill Publications*

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE34	**Digital System Design – I**	2	1	3

Section	Course contents	Hours
1.	Introduction to Digital Electronics, Digital Systems and Digital Logic. Advantages and Disadvantages of Digital Systems. Review of Digital Signals and their attributes. Review of Number systems, Radix conversion, Binary and Hexadecimal Arithmetic.9's, 10's, 1's & 2's complements and their usage, Binary codes (Weighted and non-Weighted), Error detecting and Correcting codes, Applications of various binary digital codes	8
2.	Introduction to Boolean Algebra, Theorems of Boolean algebra, Canonical forms, Representation of logical functions using Boolean Algebra, Truth Tables and Simplification using Boolean functions, Karnaugh map and Tabulation method	8
3.	Basic Logic Gates, Implementation of Boolean functions using various logic gates. Implementation of various Boolean functions using AND-OR-NOT, NAND-NAND, NOR- NOR, OR-AND-NOT and DEDICATED Gate logic	6
4.	**Digital Logic Families:** Introduction to bipolar Logic families: DDL, RTL, DTL, TTL, ECL and MOS Logic families: NMOS, PMOS, CMOS, Details of TTL logic family- Totem pole, Open collector outputs, TTL subfamilies, Comparison of different logic families on the basis of design parameters	10
5.	Multiplexers and De-multiplexers, Encoders and Decoders, Code Converters, Adders, Subtractors, Multipliers, Parity Checker and Magnitude Comparator. Multiplexer and decoder logic. Implementation of various Boolean functions using multiplexer and decoder logic	10
6.	**Introduction to Sequential logic:** Flip-flops-SR,JK,D and T flip-flops- Level triggering and edge triggering, Counters-Asynchronous and synchronous Counters, Modulo counters.	10
TOTAL HOURS FOR THE COURSE		**52**

References

1. Anil K. Maini, "Digital Electronics", Wiley.
2. Malvino and Leach, "Digital principles and Applications" Tata Mc Graw Hill.
3. Jain R P, "Modern Digital Electronics", Tata Mc Graw-Hill, Third Edition,(2003)
4. Mano M. Morris, "Digital Design", Pearson Education, Third Edition,(2006)
5. Flecther, "An Engineering Approach to Digital Design", Prentice Hall of India, New Delhi.
6. Tocci Ronald J, "Digital Systems- Principles and Applications" Prentice Hall of India, New Delhi

Course No.	Subject	Teaching Periods		Credits
		L	T	
ESCECE35	**Data Structures**	2	1	3

Section	Course contents	Hours
1	**Introduction:** Basic concept of data, structures and pointers	5
2	**Arrays:** Representation, implementation, polynomial representation. Limitations	4
3	**Strings:** Representation, String operations, Implementing String. h library functions	4
4	**Linked List:** Static and dynamic implementation. Single, double, circular, multiple linked lists	5
5	**Stacks:** Recursion and Stacks. Static and dynamic implementation. Expression evaluation. Infix, postfix expressions, multiple stacks	5
6	**Queues:** Static and dynamic implementation, circular queues, and implementation	4
7	**Hash Tables:** Hash tables implementation. Hashing techniques, single, double	4
8	**Storage Management:** Memory Management techniques, garbage collection	4
9	**Trees:** Binary trees, binary search trees, static and dynamic implementation. Tree operations, insert, delete, and search	6
10	**Heaps:** Brief introduction.	1
11	**Sorting and Searching:** Different sorting techniques. Insertion sort, selection sort, bubble sort, radix sort, quick sort, merge sort, heap sort.	6
12	**Graphs:** Representation of graphs, BFS, DFS sort. Graph Algorithms	4
TOTAL HOURS FOR THE COURSE		**52**

References

1. Data Structures by Rajni Jindal
2. Data Structures by Schaum's Series
3. Data Structures by Knuth
4. Data Structures by Farouzan
5. Data Structures using C and C++ by Langsam, A

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE32L	**Network Analysis and Synthesis Lab**	2	1

List of Experiments

1) Lissajous Patterns- Measurement of Voltage frequency and Phase of a different waveform.
2) To assemble LCR circuits and find time constant of each. Observe their performance in low pass and high pass mode.
3) For a given two port network measure:
    a. z parameters.
    b. y parameters.
    c. ABCD parameters.
    d. h parameters.
4) To experimentally determine the characteristic impedance and to plot the attenuation characteristics of the following circuits.
    a. Constant-k Low Pass Filter.
    b. Constant-k High Pass Filter.
    c. m-derived Low Pass Filter.
    d. m-derived High Pass Filter.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE33L	**Analog Electronic Circuits Lab – I**	2	1

List of Experiments

1) Introduction about basic equipments in Analog electronics lab.
2) Study of CRO & DSO - Measurement of Voltage, frequency and Phase of a given waveform.
3) Study of Function Generator and working with various signals and their attributes.
4) To study VI characteristics of a silicon rectifier Diode, Shottky barrier Diode, LED and Zener Diode using Multisim and Hardware Test bench.
5) Halfwave, Full-wave rectifier circuits and to study their performance using Multisim and Hardware Test bench.
6) To study clipping and clamping circuits on Multisim and Hardware Test bench.
7) To study voltage regulation using Zener diode.
8) Study V-I characteristics of transistor (PNP and NPN) and calculate the performance parameters of a transistor in CB and CE Configurations.
9) To assemble a CB amplifier with various biasing configurations and observe its performance.
10) To assemble a CE amplifier with various biasing configurations and observe its performance.
11) To design a practical amplifier using transistors with given specifications and parameters.
12) To Study V-I characteristics of JFET and MOSFET and determine their performance parameters.
13) To Study various FET and MOSFET configurations and their practical application circuits.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE34L	**Digital System Design Lab – I**	2	1

List of Experiments

1. To do the following:
   A. To verify the truth table of following logic gates:
      a. AND OR and NOT
      b. NAND, NOR, XOR and XNOR
   B. Design of Basic NOT, OR, AND, NAND, NOR Gates using DDL, RTL, DTL, TTL, and CMOS integrated circuits. Study of Open Collector, Open Drain and Totem-Pole Logic Family Configurations.
2. To implement XOR and XNOR using universal logic gates.
   A. To verify De-Morgan's law using logic gates.
   B. To implement certain Boolean expressions and check their equality.
3. To design and realize:-
   A. Half adder and verify its truth table.
   B. Full adder and verify its truth table.
   C. Half Subtractor and verify its truth table
   D. Full Subtractor and verify its truth table.
4. To design a multiplexer/demultiplexer using two input NAND gates
5. To design a 4 bit binary to decimal converter.
6. Design and realize the following flip flops using logic gates.
   A. RS flip flop
   B. JK flip flop
   C. D flip flop
   D. T flip flop

Course No.	Subject	Teaching Periods	Credits
		P	
ESCECE35L	**Data Structures Lab**	2	1

List of Experiments

1. Basic concepts of data, linear lists, strings, arrays and orthogonal lists, representation of trees & graphs, storage systems, Arrays, Recursion, Stacks, Queues, Linked lists, Binary trees, General Trees, Tree Traversal, Symbol Table and Searching Techniques, Sorting Techniques, graphs.
2. Implement singly and doubly linked lists.
3. Represent a polynomial as a linked list and write functions for polynomial addition.
4. Implement stack and use it to convert infix to postfix expression.
5. Implement array-based circular queue and use it to simulate a producer consumer problem.
6. Implement an expression tree. Produce its pre-order, in-order, and post-order traversals.
7. Implement binary search tree.
8. Implement priority queue using heaps.
9. Implement hashing techniques.
10. Implement various sorting techniques as taught in class.
11. Implement Dijkstra's algorithm using priority queues.
12. Implement Prim's and Kruskal's algorithms.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE36L	**EDA Tools Lab – I**	2	1

Introduction to ARDUINO

Section	Course Contents
1	**Basic IDE:** Creating and Saving a Sketch-Structuring an Arduino Program-Using Simple Primitive Types- Using Floating-Point Numbers Working with Groups of Values Using Arduino -Structuring Your Code into Functional Blocks Returning More Than One Value from a Function-Taking Actions Based on Conditions-Repeating a Sequence of Statements-Repeating Statements with a Counter-Breaking Out of Loops-Taking a Variety of Actions Based on a Single Variable-Comparing Character and Numeric Values-Comparing Strings -Performing Logical Comparisons Performing Bitwise Operations-Combining Operations and Assignment.
2	**Using Mathematical Operators:** Finding the Remainder After Dividing Two Values-Determining the Absolute Value Constraining a Number to a Range of Values Finding the Minimum or Maximum of Some Values Raising a Number to a Power Taking the Square Root Rounding Floating-Point Numbers Up and Down Using Trigonometric Functions Generating Random Numbers Setting and Reading Bits Shifting Bits Extracting High and Low Bytes in an int or long Forming an int or long from High and Low Bytes.
3	**Serial Communications:** Sending Debug Information from Arduino to Your Computer Sending Formatted Text and Numeric Data from arduino , Receiving Serial Data in Arduino Sending Multiple Text Fields from Arduino in a Single Message, Receiving Multiple Text Fields in a Single Message in Arduino Sending Binary Data from Arduino Receiving Binary Data from Arduino on a Computer Sending Binary Values from Processing to Arduino Sending the Value of Multiple Arduino Pins Logging Arduino Data to a File on Your Computer.
4	**Digital and Analog input/Output**: Using a Switch Using a Switch Without External Resistors Reliably, Detecting the Closing of a Switch Determining How Long a Switch Is Pressed Detecting Movement Detecting Light Detecting Motion (Integrating Passive Infrared Detectors) Measuring Distance Measuring Distance Accurately Detecting Vibration Detecting Sound Measuring Temperature Connecting and Using LEDs Adjusting the Brightness of an LED Driving High-Power LEDs Adjusting the Color of an LED Sequencing Multiple LEDs: Creating a Bar Graph Sequencing Multiple LEDs: Driving a 7-Segment LED Display Driving Multidigit, Increasing the Number of Analog Outputs Using PWM Extender Chips (TLC5940) Controlling Servos from the Serial Port.

Tools Required: Matlab, Labview, Arduino IDE and Supported Hardware

4th Semester

Course No.	Subject	Teaching Periods		Credits
		L	T	
BSCMTH41	**Engineering Mathematics – IV**	2	1	3

Section	Course contents	Hours
1.	Analytical Functions, C-R Equations	4
2.	Complex Integration	3
3.	Cauchy's Fundamental Theorem, Cauchy's Integral Theorem	3
4.	Cauchy's Inequality and Liouville's theorem on Integral Function	2
5.	Taylor's and Laurent's Expansions	3
6.	Zeroes and Poles of Analytic Functions	2
7.	Residues and Contour Integration	3
8.	Solution of Series	2
9.	Legendre's Functions, Rodrigues's Formula	3
10.	Generating Functions for Legendre's Polynomials and Recurrence Formulae	3
11.	Bessel's Functions	3
12.	Recurrence Formulae and Bessel's Functions of Integral Order.	3
13.	Continuous Wavelet Transform, Basic Properties of Wavelet Transform	3
14.	Discrete Wavelet Transform, Orthonormal Wavelets	3
15.	Multi Resolution Analysis	2
16.	Construction of Orthonormal Wavelets	2
17.	Daubchie's Wavelets and Algorithms	3
18.	Band limited wavelets, Balian low theorem	3
TOTAL HOURS FOR THE COURSE		**50**

References

1. Complex Variables & Applications by R. V. Churchill
2. Theory of Functions of Complex Variables by E. I. Copson

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE42	**Analog Electronic Circuits – II**	3	1	4

Section	Course Contents	Hours
1	***Differential Amplifiers*:** MOS and BJT differential pair, large signal analysis and small signal analysis of differential pairs, common mode rejection, DC offset, differential amplifiers with active loads	8
2	***Operational Amplifiers*:** Ideal Op Amp, differential and common mode signals, inverting and non-inverting configuration, open loop and closed loop gain, input and output resistance, Applications of Op Amp: integrator, differentiator, weighted summer, voltage follower, instrumentation amplifier, effect of bandwidth on circuit performance, large signal operation of Op Amps, ADC and DAC using Op Amps	8
3	***Sinusoidal Oscillators*:** Basic principle of sinusoidal oscillators, oscillation criterion, analysis of oscillator circuits using BJT, FET and Op-Amps (ring, LC, phase shift, Wein Bridge), brief discussion on crystal oscillators. Design of practical Oscillator circuits	8
4	***Waveform Shaping Circuits*:** *Bistable Multivibrators*: Feedback loop, transfer characteristics, triggering, Bistable circuit as a memory element, application as a comparator. *Astable Multivibrators*: Operation, generation of square and triangular waveforms. *Monostable Multivibrators:* Generation of a standardized pulse, 555 IC timer, Implementation of monostable bistable and astable multivibrator using 555 IC	8
5	***Output Stages and Power Amplifiers*:** Classification of output stages, Class A, Class B, Class AB and Class D output stages; circuit operation. Transfer characteristics, power conversion efficiency and power dissipation of each output stage. Power supplies and IC regulators	7
TOTAL HOURS FOR THE COURSE		**39**

References

1. Sedra A.S. and Smith K.C., Microelectronic Circuits, *Oxford University Press.*
2. Razavi B., Fundamentals of Microelectronics, *John Wiley & Sons.*
3. R. Gayakward, Operational Amplifiers, *Pearson Education*
4. Boylestad R. and Nashelsky L., Electronic Devices and Circuits, *Prentice Hall*
5. J. Millman and C. Halkias, Integrated Electronics, *McGraw Hill Publications*
6. Neamen D. A., Microelectronics: Circuit Analysis and Design, *McGraw Hill Publications*

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE43	**Digital System Design – II**	2	1	3

Section	Course contents	Hours
1.	**Review to Sequential logic:** Flip flop and Timing circuit : set-reset latches, D-flip-flop, R-S flip-flop, J-K Flip-flop, Master slave Flip flop, edge triggered flip-flop, T flip-flop. Registers & Counters: Synchronous/Asynchronous counter operation, Up/down synchronous counter, application of counter, Serial in/Serial out shift register, Serial in/parallel out shift register, parallel in/ parallel out shift register, parallel in/Serial out shift register, Bi-directional register.	8
2.	Introduction to state equations and state diagrams, design with state equation state diagram, mealy Sequential circuit design, Moore Sequential circuit design, Equivalent states and reduction of state tables, sequential circuit timing, Tri-state logic and buses.	7
3.	**Data-conversion circuits:** Digital –to-analogue converters, D/A converters specifications, Types of D/A converters, D/A converters application, Integrated circuits D/A, A/D converters, A/D converters specifications, Types of A/D converters, , Integrated circuits A/D converters, A/D converters applications.	6
4.	Memory organization, Classification, and characteristics of memories, Sequential memories, ROMs, R/W memories, Content Addressable memories, CCD memory, PLA, PAL and Gate Array, introduction to CPLD and FPGA.FPGA Architecture.	6
5.	**Introduction to VHDL**: Computer-aided design, Hardware Description Languages, VHDL description of combinational circuits, VHDL modules, VHDL models for multiplexers, Modeling combinational circuits using VHDL Processes, Variables, signals and constants, Arrays and loops in VHDL, VHDL data-types and operators, , VHDL libraries and Packages, IEEE Standard logic, Compilation, Simulation of VHDL Code.	10
6.	**VHDL for Sequential Logic:** Modeling Flip-flops using VHDL Processes, Modeling Registers and counters using VHDL Processes, Modeling a sequential machine, Synthesis of VHDL code, More about Processes and sequential statements.	8
7.	**VHDL for digital system design:** VHDL code for BCD to seven-segment decoder, VHDL code for BCD adder, VHDL code for serial adder, VHDL code for binary multiplier, VHDL code for 4x4 array multiplier, VHDL code for binary divider.	7
TOTAL HOURS FOR THE COURSE		**52**

References

1. Anil K. Maini, “Digital Electronics”, Wiley.
2. Charles H. Roth, “Digital System Design using VHDL”, Thomson
3. Mano M. Morris, “Digital Design”, Pearson Education, Third Edition,(2006)
4. Tocci Ronald J, “Digital Systems- Principles and Applications” Prentice Hall of India, New Delhi
5. Charles H. Roth, “Fundamentals of logic design”, CENGAGE Learning

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE44	**Signals and Systems**	2	1	3

Section	Course contents	Hours
1	**Introduction to signals and Systems Representation:** Classification of signals and systems: Introduction to signals and systems, Continuous time and discrete time signals.	3
2	Classification of CT and DT signals -periodic and non-periodic, Even and Odd, Power and Energy, Invertible and Non-invertible, Deterministic and Random.	4
3	Elementary signals - exponential, sine, step, impulse and its properties, ramp, rectangular, sine, triangular, signum, Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration(Accumulator for DT), time scaling, time shifting and folding.	5
4	System viewed as interconnection of of operations, properties of systems, sampling theorem, graphical and analytical proof of band limited signals.	4
5	System: definition, classification – Linear and Non-Linear, Time Variant and Time Invariant, Causal and Non-causal, Stable and Unstable (BIBO stability), Static and Dynamic.	4
6	**Fourier Analysis:** Analysis of continuous time signals: Definition and necessity of CT and DT Fourier series and Fourier transforms.	4
7	Fourier series representation of continuous time and discrete time periodic signals - properties of continuous time and discrete time Fourier series.	4
8	Continuous Time Fourier Transform (CTFT), amplitude and phase spectra of CT signals, Properties of CTFT, convolution and multiplication property of CTFT, systems characterized by Linear Constant Coefficient Differential Equations, Limitations of FT and need of LT and ZT.	4
9	Laplace Transform – ROC, poles and zeros, Properties of Laplace Transform, inverse Laplace transform, relation between Laplace transform and Fourier transform.	3
10	**Analysis of Continuous time LTI Systems:** Laplace Transform: Linear time invariant –continuous time systems: Differential equation and Block diagram representation of LTI systems, Impulse response and properties of LTI systems.	3
11	Convolution integral, properties of convolution, frequency response, State variable equations and matrix representation of systems, Analysis and characterization of LTI systems using Fourier and Laplace transform.	3
12	Computation of impulse response, transfer function, causality and stability using Laplace Transform, Unilateral Laplace transform & its applications to solve differential equations.	5
13	**Analysis of Discrete Time Systems:** Introduction Z-Transform: Analysis of discrete time signals and systems: Sampling of CT signals and aliasing, DTFT and properties, Unilateral Z-Transform & its applications to LTI Systems described by difference equations.	5
TOTAL HOURS FOR THECOURSE		**50**

References

1. Oppenheim A. V., Wilsky A. S. and Nawab S. H., Signals and Systems, *Pearson Education*
2. Haykin S. and Veen B. V., Signals and Systems, *John Wiley and Sons*
3. Roberts M. J., Signals and Systems: Analysis Using Transform Method and MATLAB, *Tata McGraw Hill*

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE45	**Electromagnetic Fields and Waves**	2	1	3

Section	Course contents	Hours
1.	Review of Electric Field Coulombs law, Electric field due to a point charge, surface charge and volume charge, divergence and curl of E, Electric potential	6
2.	Review of Magnetic Field, Lorentz law, Biot-Savarts law, B due to line current, Surface current and volume current densities, Divergence and curl of B, Magnetic Potential	6
3.	Maxwell's Equations, Maxwell's equations in Electrostatics and magneto-statics, in medium, Maxwell's equation	6
4.	Potential functions, Boundary conditions	4
5.	Wave equation and its solution	4
6.	Electromagnetic Waves, Poynting Theorem	4
7.	Phase and group velocity	4
8.	Plane waves in lossless and lossy media,	4
9.	Wave propagation in Ferrites-Faraday Rotation and Bire frigerence.	4
10.	Normal and oblique incidence at plane conducting boundary	4
11.	Normal and oblique incidence at plane dielectric boundary	4
TOTAL HOURS FOR THE COURSE		**50**

References

1. Jordan E and Balman K: Electromagnetic Waves & Radiating Systems, PHI
2. David K. Cheng: Field and Wave Electromagnetics, Addison Wesley
3. Krauss: Electromagnetics, Mc Graw Hill.
4. Griffiths: Introduction to Electrodynamics, PHI

Course No.	Subject	Teaching Periods		Credits
		L	P	
ESCECE46	**OOPS with Java**	2	2	3

Section	Course Content	Hours
1.	**Introduction to Java** Definition, History of Java, The Internet and Java's Place of IT, Applications and Applets, Java Virtual Machine, Byte Code- Procedure Oriented vs. Object-Oriented Programming, Compiling and Running a Simple Program, Setting up your Computer for Java Environment, Writing a program, Compiling, Interpreting and Running the Program, Handling Common Errors.	4
2.	**Tokens, Expressions and Control Structures** Primitive Data Types,User Defined Data Types, Declarations, Constants, Identifiers, Literals, Type Conversion and Casting, Variables: Arrays of Primitive Data Types, Comment Syntax, Garbage Collection, Expressions, Using Operators: Using Control Statements	5
3.	**Object Oriented Programming Concepts** Fundamentals of Classes: A Simple Class, Creating Class Instances, Adding methods to a class, Calling Functions/Methods, Abstraction, Encapsulation, Using 'this' Keyword, Constructors, Default constructors, More on methods: Passing by Value,by Reference, Access Control, Methods that Return Values, Polymorphism and Method Overloading, Recursion; Nested and Inner Classes	8
4.	**Inheritance & Packaging** Inheritance: Using 'extends' keyword, Subclasses and Superclasses, 'super' keyword usage. Overriding Methods, Dynamic Method Dispatch; The Object class, Abstract and Final Classes, Package: Access Control; Interfaces: Defining an Interface, Implementing and applying interfaces.	4
5.	**Handling Error / Exceptions** Basic Exceptions, Proper use of exceptions, User defined Exceptions, Catching Exception: try, catch; Throwing and re-throwing: throw, throws; Cleaning up using the finally clause.	2
6.	**. Handling Strings** Creation, Concatenation and Conversion of a String, Changing Case, Character Extraction, String Comparison, Searching Strings, Modifying Strings, String Buffer.	2
7.	**Threads** Create/Instantiate/Start New Threads: Extending java.lang.Thread, Implementing java.lang.Runnable Interface; Understand Thread Execution, Thread Priorities, Synchronization, Inter-Thread Communication, Deadlock.	7
8.	**I/O and Streams**java.io package, Files and directories, Streams and Character Streams; Reading/Writing Console Input/Output, Reading and Writing files, The Serialization Interface, Serialization & Deserialization	2
9.	**Understanding Core Packages** Using java.lang Package: java.lang.Math, Wrapper classes and associated methods (Number, Double, Float; Integer, Byte; Short, Long; Character, Boolean); Using java.util package: Core classes (Vector, Stack, Dictionary, Hashtable, Enumerations, Random Number Generation).	3
10.	**Holding Collection of Data** Arrays And Collection Classes/Interfaces, Map/List/Set Implementations: Map Interface, List Interface, Set Interface, Collection Classes: Array List, Linked List, Hash Set and Tree Set, Accessing Collections/Use of An Iterator, Comparator.	3

11.	**Java Applications** About AWT & Swing, About JFrame (a top level window in Swing), Event Handling in Swing Applications, Layout Management using FlowLayout, Border Layout, Grid Layout, Using JPanel, Choice components like JCheck Box, JRadio Button, Borders components, JCombo Box & its events, JList& its events with MVC patterns,	8
12	**Introduction to Java Applets** Definition, Applet lifecycle methods, Build a simple applet, Using Applet Viewer, Adding Controls: Animation Concepts.	1
13	**Database Programming using JDBC** Using Connection, Statement & Result Set Interfaces for Manipulating Data with the Databases.	2

Books

1. The Java Tutorial: A Short Course on the Basics (The Java Series) 6th Edition by Raymond Gallardo , Scott Hommel, Sowmya Kannan, Joni Gordon, Sharon Biocca Zakh
2. Thinking in Java 4th Edition by Bruce Eckel
3. Java the Complete Reference latest edition Herbert Schildt
4. Head First Java by Kathy Sierra O'Reilly publication

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE42L	Analog Electronic Circuits Lab – II	2	1

List of Experiments

1) To assemble current series feedback amplifier and study its performance.
2) To assemble a voltage shunt feedback amplifier and study its performance.
3) To design RC phase shift oscillator using OPAMP/BJT.
4) To assemble a differential amplifier and obtain its CMRR.
5) To study different applications of OP AMPS.
    a. OP-AMP as voltage comparator
    b. OP-Amp as Zero Crossing Detector
    c. OP-AMP as an inverting amplifier.
    d. OP AMP as a non -inverting amplifier
    e. OP AMP as an integrator
    f. OP AMP as a differentiator
6) To measure the following parameters of a typical OP-AMP.
    a. I/P Impedance
    b. O/P Impedance
    c. Slew rate
    d. CMRR
7) Obtain frequency response of an OP-AMP & hence find its bandwidth.
8) Study performance of multivibrator circuits using 555 chip in following modes:
    a. Bistable
    b. Astable
    c. Monostable
    d. Use of 555 Chip as a timer circuit.
9) To assemble a Schmitt trigger Circuit and to obtain its characteristics and to use it as squaring circuit.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE43L	**Digital System Design Lab – II**	2	1

List of Experiments

Experiments on Design using VHDL and Implementation using Xilinx/Spartan Kits: Combinational Design & Implementation Exercises:

1. Design and implementation of basic Gates: AND, OR, NOT.
2. Design and implementation of universal gates.
3. Design and implementation of 2:1 Mux using other basic gates.
4. Design and implementation of 2 to 4 Decoder.
5. Design and implementation of Half-Adder, Full Adder, Half Subtractor, Full Subtractor.
6. Design and implementation of 3:8 Decoder.
7. Design and implementation of 8:3 Priority Encoder.
8. Design and implementation of 4-Bit Binary to Grey code Converter.
9. Design and implementation of 4-Bit Binary to BCD Converter using sequential statement.
10. Design an 8-Bit parity generator (with for loop and Generic statements).
11. Design and implementation of 2's Complementary for 8-bit Binary number using Generate statements.

Sequential Design & Implementation Exercises:

12. Design and implementation of all type of Flip-Flops using (if-then-else) Sequential Constructs
13. Design and implementation of 8-Bit Shift Register with shift Right, shift Left, Load and Synchronous reset.
14. Design and implementation of Synchronous 8-bit Johnson Counter.
15. Design and implementation of counters (MOD3, MOD5, MOD8, MOD16).
16. Design and implementation of a decimal up/down counter that counts up from 00 to 99 or down from 99 to 00.
17. Design and implementation of 3-line to 8-line decoder with address latch.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE44L	**Signals and Systems Lab**	2	1

List of Experiments

1. Introduction to:
    a. MATLAB
    b. Basic operations on matrices
    c. Logical operations and loops
    d. Function files etc
2. Generation of various signals and sequences
3. Operation on signals and sequences
4. Generation of even & odd components of a signal
5. Check different properties of given systems
6. Perform convolution of continuous time signals & discrete time sequences
7. Auto correlation and Cross correlation
8. Gibbs phenomenon
9. Fourier analysis of periodic signals using a) trigonometric Fourier series b) using exponential Fourier series
10. Plot magnitude and Phase response of a given system.
11. Inverse Fourier transform
12. Properties of Fourier transform (linearity, scaling, shifting, duality, differentiation etc)
13. Laplace transform and it's Inverse
14. Discrete time Fourier transform and it's Inverse
15. Z-transform and its Inverse

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE46L	**EDA Tools Lab – II**	2	1

Introduction to MATLAB

1. Introduction to MATLAB and its workspace.
2. Working with matrices: creation of 1d, 2d, 3d and nd matrices, acquisition of matrices, processing and operations on matrices.
3. Various plotting tools. Plotting vector and matrix data, Plot labeling, curve labeling and editing, 2D and 3D plot, surface, mesh and grid plotting.
4. Working with Complex numbers and their operations.
5. MATLAB Programming: Automating commands with scripts, writing programs with logic and flow control, Writing functions, Control statement Programming, Conditional Statement Programming, Examples.
6. M files: Working with script tools, Writing Script file, executing script files, The MATLAB Editor, Saving m files.
7. GUI Design: Introduction Of Graphical User Interface, GUI Function Property, GUI Component Design, GUI Container, Writing the code of GUI Callback, Dialog Box, Menu Designing, Applications.
8. MATLAB SIMULINK: Introduction of SIMULINK, SIMULINK Environment & Interface, Study of Library, Circuit Oriented Design, Equation Oriented Design, Model, Subsystem Design, Connect Call back to subsystem, Application.
9. Image Processing with MATLAB: Importing and Visualizing Images, Importing and displaying images, converting between image types, Exporting images, Interactive Exploration of Images.
10. Symbolic Math in MATLAB: Calculus-Numerical Integration, Linear Algebra, Roots of Polynomials, Algebraic equations, Differential Equations (1st & 2nd order), Transforms (Fourier, Laplace, etc), Ordinary Differential equations, Examples of few ODEs.

Introduction to PCB Design

1. Definition and Need/Relevance of PCB, Background and History of PCB, Types of PCB, Classes of PCB Design, Terminology in PCB Design, Different Electronic design automation (EDA) tools and comparison. PCB Design Process, PCB Design Flow, Placement and routing, Steps involved in layout design, Artwork generation Methods - manual and CAD, General design factor for digital and analog circuits, Layout and Artwork making for Single-side, double-side and Multilayer Boards. Design for manufacturability Design-specification standards.

2. Introduction to PCB Fabrication & Assembly, Steps involved in fabrication of PCB. PCB Fabrication techniques-single, double sided and multilayer, Etching: chemical principles and mechanisms, Post operations- stripping, black oxide coating and solder masking, PCB component assembly processes.

3. Using any Electronic design automation (EDA) software, Practice following PCB Design steps (Open source EDA Tool KiCad Preferable) Example circuit: Basic RC Circuit ,Schematic Design: Familiarization of the Schematic Editor, Schematic creation, Annotation, NETLIST generation, Layout Design: Familiarization of Footprint Editor, Mapping of components, Creation of PCB layout Schematic, Create new schematic components, Create new component footprints.

5th Semester

Course No	Subject	Teaching Periods		Credits
		L	T	
PCCECE51	**Information Theory and Coding**	2	1	3

Section	Course Contents	Hours
1.	**Introduction to probability**, Bayes Theorem- concept of random variable-probability density and distribution functions, function of a random variable.	10
2.	Moments, Independence of a random variable. Introduction to random process and random sequences, concept of stationarity.	10
3.	**Channel Coding:** Mutual information and its properties, information rate, channel capacity, Shannon's Channel Coding Theorem, Discrete channels – Symmetric channels, Binary Symmetric Channel, Binary Erasure Channel, Differential Entropy, Capacity of AWGN Channel.	10
4.	**Error Control Codes:** Repetition Coding, Linear Block Codes, Cyclic Codes, Syndrome Decoding, Convolutional Codes, Viterbi Decoding.	10
5.	**Recent Trends in Information and Coding Theory:** Codes for 5G/6G: LDPCCodes, Polar Codes; Information theory for machine learning; Quantum Information and computing.	10
	TOTAL HOURS FOR THE COURSE	**50**

References

1. Elements of Information Theory by Thomas, Joy A., and Cover, Thomas M.; Wiley, 2012.
2. Digital Communication Systems by Haykin, Simon; United Kingdom, Wiley.
3. Digital Communications by Proakis, John G., and Salehi, Masoud United States; McGraw-Hill, 2008.
4. Information theory: coding theorems for discrete memoryless systems by Csiszar, Imre, and János Körner; Cambridge University Press, 2011.
5. Error control coding by Lin, Shu, and Daniel J.Costello; Pearson Education India, 2011.
6. Selected papers from IEEE Transactions on Information Theory and other reputed journals/conference papers related to Information Theory and Coding.

Course No	Subject	Teaching Periods		Credits
		L	T	
ESCECE52	**Digital Signal Processing**	2	1	3

Section	Course Contents	Hours
1.	Introduction to Digital Signal Processing, Limitations of analog signal processing, Advantages of digital signal processing and its applications	2
2.	Introduction to Digital Signal processors, types of Digital Signal Processors, Various practical DSP's, Digital Signal Processor Architecture, comparative study between a General-Purpose Processor and Digital Signal Processor	4
3.	Signal Processing: Review of elementary discrete time sequences and systems, convolution, correlation, LTI system, Concepts of stability, causality	3
4.	Difference Equations and its Solution	3
5	Review of Z transform (unilateral/bilateral) and properties, Application to difference equations	3
6.	Sampling of Continuous Time Signals: Sampling and aliasing problem, Reconstruction of a continuous time signal from its samples	3
7.	Discrete Time Processing of Continuous time signals and vice-versa. Decimation & Interpolation; changing the sampling rate	5
8.	Frequency Domain Representation of Discrete Time Signal and Systems. Review of DTFT Discrete Fourier Transform: DFT and its properties; Linear Periodic and Circular Convolution	7
9.	Linear Filtering using DFT, Filtering of long data sequences	2
10.	Fast Fourier Transform algorithm using decimation in time and decimation frequency techniques; Linear filtering approaches to computation of DFT	5
11.	FIR and IIR systems, Basic Structures of Discrete Time Systems, Block Diagram representation of Linear Constant coefficient Difference equations, Signal flow graph, basic structures of IIR and FIR systems	5
12.	Design of Discrete time IIR filters from continuous time filters, Impulse Invariance, Bilinear Transformation, etc., Butterworth, Chebyshev filters	4
13.	Linear Phase FIR filters, Design of FIR filters by windowing (hamming, hanning, keiser etc.)	4
TOTAL HOURS FOR THE COURSE		**50**

References

1. A textbook of DSP Techniques by Steven W. Smith
2. Digital Signal Processing using John. G. Proakis and Dimitry G. Manolakis.
3. Digital Signal Processors, B. Venkataramani & M. Bhaskar, Tata McGrawHill

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE53	**Communication Systems – I**	3	1	4

Section	Course contents	Hours
1.	Review of basic signal and systems, Introduction to Communication System (Analog and Digital), Basic block diagram of communication system, Channel, modulation, need for modulation, properties of Fourier transform enabling modulation (Duality, frequency shifting)	8
2.	Analog modulation: Amplitude Modulation: AM, DSB/SC, SSB, VSB etc. Generation and detection, waveforms, mathematical expressions for performance parameters, Advantages/Disadvantages and Applications. Frequency division multiplexing, Time division multiplexing.	8
3.	Angle modulation: Phase modulation and Frequency modulation: FM (NBFM, WBFM): Generation (Direct and Indirect Methods) and detection (Phase and frequency Discrimination), waveforms, mathematical expressions for performance parameters, Advantages/Disadvantages and Applications. Carson's rule.	8
4.	AM & FM Receivers (Tuned Radio Frequency and Super Hetero-dyne), Image frequency, Image rejection ratio, selectivity, sensitivity, fidelity.	6
5.	Pre-emphasis and De-emphasis in FM Systems.	1
6.	Introduction to Noise, types of noise, Performance of AM & FM Systems in presence of noise.	3
7.	Sampling, over sampling, critical sampling and under sampling.	3
8.	Introduction to digital communication techniques, advantages disadvantages with respect to analog communication, applications,	2
9.	Pulse analog modulation (introduction and types), Pulse digital modulation, ASK, FSK, PSK, DPSK, QPSK, QAM, M-ary PSK, ASK, FSK: Generation, detection, waveforms, analysis, constellation diagrams.	8
10.	Probability of error, Calculation of error probability of ASK, BPSK, BFSK, QPSK	3
TOTAL HOURS FOR THE COURSE		**50**

References

1. Principles of Communication Systems by Taub & Schelling.
2. Electronic Communication Systems by G. Kennedy.
3. Communication systems by S. Haykins.
4. Principles of electronic communication systems LE Frenzel – 2007.
5. Advanced Electronic Communications Systems W. Tomasi

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE54	**Microprocessors**	2	1	3

Section	Course contents	Hours
1.	Microcomputer Structure and Operations: Basic Microcomputer Elements	3
2.	Typical Microcomputer Structure	2
3.	CPU, Memory System	3
4.	Input Output	3
5.	Microprocessors and Memory: Typical 8, 16- and 32-bit Microprocessors	5
6.	8085 Microprocessor Specification	2
7.	Memory Technologies	2
8.	Assembly Language Programming I: Programming Model of 8085, Registers, Fetch, Execute Operation of CPU, Instruction Set	6
9.	Assembly Language Programming II: Addressing Modes, Basic Operations, Microprocessor Arithmetic, Program Flow Control Using Looping and Branching	6
10.	Assembly Language Programming III: Stack, Subroutines, Interrupts, Resets	6
11.	Bus System: System Bus Structure, Bus Operations, Cycle by Cycle Operations, Timing and Control, Priority Management, Address Decoding	6
12.	Microprocessors Interfacing: Interfacing concepts, Parallel Input Output, Memory Interfacing, Direct Memory Access, The Serial Subsystems, Peripheral Interface, Analog Converter Subsystem	6
TOTAL HOURS FOR THE COURSE		**50**

References

1. Microprocessor Architecture, Programming & Applications by Ramesh Goankar
2. Microprocessor & Applications by Leventhal.
3. Microprocessors by Mathur.

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE55	**Control Systems**	2	1	3

Section	Course contents	Hours
1	Introduction to linear Control System: Control Systems, types of control systems, feedback and its effects, mathematical modeling of physical systems	5
2	System Representations: transfer functions, block diagram representation, signal flow graphs	5
3	Time Domain Analysis of Control Systems: Typical test signals for time response of control systems, time domain performance of first and second order control systems (steady state response and transient response), Steady state error analysis	8
4	Stability of Control Systems: Stability characteristic equation, stability of linear time invariant systems, Rough-Hurwitz Criterion	6
5	Frequency Domain Analysis of Control Systems: Frequency domain characteristics second order systems relative stability, Nyquist criterion, Bode Plot, Root locus plot	10
6	Proportional, Integral, Derivative Control (PID). Lag, lead and lag lead compensation	8
7	Introduction to Modern Control Theory: State Equations, State Transition Matrix, State transition equations, State Diagrams, concept of controllability and observability	8
TOTAL HOURS FOR THE COURSE		**50**

References

1. Modern Control Engineering by K.Ogatta
2. Automatic Control Systems by Benjamin C.Kuo

Course No.	Subject	Teaching Periods	Credits
		P	
ESCECE52L	Digital Signal Processing Lab.	2	1

List of Experiments

1. Familiarization with DSP processor TMS 320 C 6713.
2. Write a program to generate a sine/triangular/square wave.
3. Write a program to generate a sine/triangular/square wave of variable. Amplitude and frequency.
4. Write a program to generate AM signal.
5. Write a program to generate an echo of an audio signal.
6. Write a program to perform convolution of two signals.
7. Write a program to perform DFT & IDFT of a signal.
8. Write a program to design a low pass audio digital filter.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE53L	**Communication Systems Lab – I**	2	1

List of Experiments

1. Generation and detection of amplitude modulated signals.
2. Generation and detection of frequency modulated signals.
3. To measure sensitivity, selectivity, and fidelity of a radio receiver.
4. To test a pulse code modulator.
5. Study different line Encoding Schemes.
6. Generation and detection of Digital Modulation techniques.
7. Noise Analysis of AM & FM.

Note: Lab kits are to be used for demonstration only, the practical shall be realized using discreet components where ever applicable.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE54L	**Microprocessors Lab**	2	1

List of Experiments

1.
i) To develop a program to add two double byte numbers.
ii) To develop a subroutine to add two floating point quantities.
2.
i) To develop program to multiply two single byte unsigned numbers, giving a 16-bit product
ii) To develop subroutine which will multiply two positive floating-point numbers.
3. To write program to evaluate P* Q*+R* & S are 8-bit binary numbers.
4. To write a program to divide a 4-byte number by another 4-byte number.
5. To write a program to divide an 8-bit number by another 8 bit number upto a fractional quotient of 16 bit.
6. Write a program for adding first N natural numbers and store the results in memory location X.
7. Write a program which decrements a hex number stored in register C. The Program should half when the program register reads zero.
8. Write a program to introduce a time delay of 100 ms using this program as a subroutine display numbers from 01H to OAH with the above calculated time delay between every two numbers.
9. N hex numbers are stored at consecutive memory locations starting from X. Find the largest number and store it at location Y.
10. Interface a display circuit with the microprocessor either directly with the bus or by using I/O ports. Write a program by which the data stored in a RAM table is displayed.
11. To design and interface a circuit to read data from an A/D converter, using the 8255 A in the memory mapped I/O.
12. To design and interface a circuit to convert digital data into analog signal using the 8255A in the memory mapped I/O.
13. To interface a keyboard with the microprocessor using 8279 chip and transfer the output to the printer.
14. To design a circuit to interface a memory chip with microprocessor with given memory map.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE55L	**Control Systems Lab**	2	1

List of Experiments

1. Study working of PID Trainer Kit/MATLAB for various controller configurations.
2. Use of SIMULINK for response study of inputs like:
   i. Step
   ii. Ramp

for systems of various orders: with and without feedback.

3. Write a MATLAB program to find:
   a. Step response of a first order system.
   b. Impulse response of first order system.
4. Write a MATLAB program to obtain impulse, step& ramp response of a second order system.
5. Write a MATLAB program to find rise-time, peak-time, maximum overshoot &settling time of second order systems.
6. Write a MATLAB program to find unit step response of second & higher order systems.
7. Write a MATLAB program to plot root locus of second & higher order system & hence comment on stability.
8. Write a MATLAB program to demonstrate effect of addition of poles & zeros to a transfer function.
9. Write a MATLAB program to obtain Bode plot of transfer function. Find gain margin & hence comment on stability.
10. Write a MATLAB program to determine Polar plot of a given transfer function.
11. Write a MATLAB program to draw NYQUIST plot of a second& higher order system.

Note: Lab kits may also be used where ever applicable.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE56L	**EDA Tools Lab – III**	2	1

PYTHON for Engineers

Section	Course Contents
1	**UNIT I** Introduction, Computational Modelling, Programming to support computational modelling ,Why Python for scientific computing, Optimisation strategies, Get it right first, then make it fast , Prototyping in Python, Literature Recorded video lectures on Python for Python prompt and Read-Eval-Print Loop (REPL) Integer division How to avoid integer Data Types and Data Structures Integers Long integers Floating Point numbers Complex numbers
2	**UNIT II** Sequence String, List, Tuples Indexing sequences, Slicing, Passing arguments to functions, Call by value Call by reference Argument passing in Python, Performance considerations, Inadvertent modification of data, Equality and Identity, Input and Output: Printing to standard output.
3	**UNIT III** Conditionals: If-then-else For loop While loop Relational operators (comparisons) in if and while Exceptions Raising Exceptions Creating our own exceptions LBYL vs EAFP Functions and modules Introduction Using functions Defining functions, Default values and optional parameters
4	**UNIT IV** SymPy: Numeric types Differentiation and Integration, Ordinary differential equations Series expansions and plotting Linear equations and matrix inversion Nonlinear equations Output: LATEX interface and pretty-printing Automatic generation of C code
5	**UNIT V** Numerical Computation, Numbers and numbers, Limitations of number types Using floating point numbers (carelessly) Using floating point numbers carefully Numerical Python (numpy): arrays Numpy introduction Arrays Convert from array to list or tuple Standard Linear Algebra Operations More numpy examples Numpy for Matlab users
6	**UNIT VI** Visualising Data Matplotlib (Pylab) Matplotlib and Pylab IPython's inline mode Histograms Visualising matrix dataVisual Python Basics, rotating and zooming Setting the frame rate for animations Tracking trajectories Connecting objects (Cylinders, springs)
7	**UNIT VII** Numerical Methods using Python (scipy) Overview SciPy Numerical integration Solving ordinary differential equations

Note: Implement using raspberry pi.

References

1. Python The Complete Reference by Martin C. Brown, Tata McGraw-Hill Education India
2. Python Crash Course by Eric Matthes published by O'Reilly
3. Python Cookbook: Recipes for Mastering Python 3 (3rd Edition) published by O'Reilly

Tools Required: ANACONDA, GOOGLE COLAB.

6th Semester

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE61	**Communication Systems – II**	3	1	4

Section	Course contents	Hours
1.	Waveguides and Cavity Resonators, Transverse Electric and Transverse magnetic Waves	3
2.	Wave propagation through rectangular and circular waveguides, Power transmission and attenuation in waveguides	4
3.	Electromagnetic Resonators, Rectangular & Circular cavities	4
4.	Strip Lines: Propagation Constant, Characteristic impedance and attenuation characteristics of strip lines and micro-strips	4
5.	Propagation of Waves: Waves in free space, Attenuation, Absorption and polarization, effects of Environment	5
6.	Ground wave propagation, sky wave propagation, space wave propagation	5
7.	Troposcatter propagation a n d Extra-terrestrial propagation	3
8.	Radiation: Retarded Potential and Electromagnetic field, Radiation from a short current element	3
9.	Half wave dipole, Radiation Resistance, Effect of ground on radiating elements	3
10.	Antennas: Basic Antenna parameters, Radiation pattern, Directivity and Antenna Gain	3
11.	Bandwidth and beam-width, Polarization	3
12.	Folded dipole and applications. Antenna arrays	3
13.	Parabolic reflector, Properties and feed mechanism	2
14.	Horn Antenna, Loop Antenna	1
15.	Satellite Communication	4
TOTAL HOURS FOR THE COURSE		**50**

References

1. Liao, S. Y: Microwave Devices & Circuits, PHI
2. David Pozar: Microwave Engineering, John Wiley
3. Jordan, E and Balman, K: Electromagnetic Waves & Radiating Systems, PHI
4. Krauss, J.D: Antennas, Mc Graw Hill.

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE62	**Microcontrollers and Embedded Systems**	2	1	3

Section	Course contents	Hours
1.	Introduction to embedded systems, Embedded System applications, Overview of Microcontrollers, choosing a Microcontroller for an embedded application	4
2.	8051 Microcontroller hardware, internal Architecture, input/output pin and port architecture	4
3.	Instruction Set of 8051, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction	4
4.	Addressing modes, accessing memory using various addressing modes with assembly code examples	2
5.	Single bit instructions and programming, I/O port programming: I/O programming, bit manipulation	3
6.	8051 programming in C, 8051 Hardware Connection and Hex File	4
7.	Timer and counter architecture in 8051, programming 8051 timers, counter programming, Examples of Timers and Counters using Assembly and C programming Language	4
10.	Interfacing LCD with 8051 using C programming Language	4
11.	Interfacing Keyboard using C programming Language	4
12.	Interfacing A/D & D/A converters with programming examples	4
13.	Interfacing 8051 with DC Motor, Relay, Stepper-motor, and Servomotor	8
14.	Intel Programmable peripheral interface (PPI)-8255, 8255 interfacing with 8051	2
TOTAL HOURS FOR THE COURSE		**50**

References

1. The 8051 Microcontrollers and Embedded Systems: Muhammed Ali Mazidi; Pubisher: Pearson Publication
2. The 8051Microcontrollers Architecture, Programming & Applications Kenneth J.AyalaPenram International Publishing
3. 8051 Microcontroller: Internals, Instructions, Programming and Interfacing: Subrata Ghoshal Publisher: Cengage Learning Asia
4. Embedded Systems & Robots : Projects Using the 8051 Microcontroller: Subrata Ghoshal Publisher: Cengage Learning Asia.

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE63	Electrical Machines	2	1	3

Section	Course contents	Hours
1.	Transformers: Operating principle, classification, construction, emf equation, phasor diagrams, equivalent circuit model, losses & efficiency, voltage regulation, frequency response, polarity test	6
2.	Autotransformers, three- phase transformer connections, impedance matching	4
3.	Isolation & instrument transformers	3
4.	D.C. Machines: Operating principle, generator & motor action, construction, types of excitation, emf & torque equations, power stages & efficiency. Commutation & Armature Reaction	6
5.	Characteristics & application of d.c generators, starting & speed control of d.c motors	4
6.	Characteristics & applications of d.c motors	3
7.	Electric braking	1
8.	Induction Machines: Three-phase induction motors. Principle of operation, construction, types	3
9.	Rotating magnetic field, emf equation of an AC Machine, torque developed in an induction motor, equivalent circuit model, torque-speed characteristics, starting & speed control	6
10.	Single phase induction motors, starting, application	3
11.	Synchronous Machines: Construction, types & operating principle of synchronous generator, A.C armature windings, equivalent circuit, phasor diagrams, voltage regulation, parallel operation, synchronization, Power Angle characteristics, effect of field excitation change	6
12.	Synchronous Motor, principle, starting, hunting, damper windings	3
13.	Special Purpose Motors: Stepper Motor, Universal Motor, Shaded-pole Motor	4
TOTAL HOURS FOR THE COURSE		**52**

References

1. Electric Machinery by Fitzgerald
2. Electric Machinery by Nagrath

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE64	**Electronic Measurement & Instrumentation**	2	1	3

Section	Cour	Hours
1	Measurement System and Standards: Instrumentation system and its classification, Primary and secondary standards, Standards of various	6
2	Static and Dynamic response	2
3	Measurement Errors, and accuracy of an instrumentation system	3
4	Signal Generators and Analyzers: Function generators, RF Signal Generator, Sweep Generator, Frequency synthesizer, Wave Analyzers for Audio and radio frequency waves. Measurement of harmonic distortion. Spectrum analysis	4
5	**Mechanical and Electromechanical sensor** • Resistive (potentiometric type) • Strain gauge • Inductive sensor • LVDT • Proximity sensor	4
6	**Capacitive sensors:** Piezoelectric element force & stress sensing, ultrasonic sensors	4
7	**Thermal sensors:** Resistance change type (RTD, Thermistor), Thermocouple, Radiation sensors (Pyrometer)	4
8	**Optical sensors:** LDR, Photovoltaic cells, Photodiodes	3
9	Introduction to Smart Sensors	3
10	Definition, advantages and Importance of PLC, Evolution history of PLC, architecture and block diagram	5
11	PLC hardware Types of PLC, CPU unit architecture, Memory classification, Input/output devices and it's interfacing, Digital-Analog modules, Communication modules, Special function modules	12
TOTAL HOURS FOR THE COURSE		**5**

References

1. Electronic Measurements by W. Cooper
2. Electrical & Electronic Measurements by A.K. Sawhney

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE65	**VLSI Design**	2	1	3

Section	Course contents	Hours
1	Review of MOSFET: Constructional & Operational features of MOSFET	3
2	I-V Equation, Second Order Effects	3
3	MOS Capacitor, C-V Characteristics	2
4	MOSFET Switch, Transmission gate	2
5	CMOS Inverter (Pull-up & Pull-down), Inverter Static Characteristics, Noise Margin	3
6	Switching characteristics of Inverter (Fall Time, Rise Time, Delay Time), Dynamic Characteristics, Power Dissipation	3
7	VLSI Technology: Wafer Processing, Oxidation, Epitaxy, Deposition, Ion- Implantation & Diffusion	4
8	The Silicon gate Process, n-well CMOS Process, p-well Process, Twin-Tub Process, Silicon On Insulator	4
9	CMOS Logic Design (Gates): CMOS Logic Gate Design (NAND & NOR Logic)	3
10	Switching Characteristics (Delay Time, Power, Fan-in, Fan-out), Transistor Sizing, The Compound Gates	4
11	CMOS Logic Structures: CMOS Logic, Pseudo-nMOS Logic, Dynamic CMOS Logic, C2MOS Logic, BiCMOS Logic, NP Domino Logic	5
12	Layout: Design Rules/Floor planning, Simple Layout Examples	5
13	CMOS Logic Design (Circuits): Multiplexers, MUX Implementation in CMOS & Transmission Gate	4
14	RAM Cell Implementation, Implementation of Flip-Flop, Register/Counters	5
TOTAL HOURS FOR THE COURSE		**50**

References

1. CMOS VLSI Design: A Systems Perspective by N. Weste & K. Eshraghian
2. CMOS VLSI Design: A Circuits & Systems Perspective by N. Weste, D. Harris & A. Bannerjee
3. Digital Integrated Circuits: A Design Perspective by Rabaey

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE61L	**Communication Systems Lab – II**	2	1

List of Experiments

1. To measure and plot radiation pattern of different antennas yagi-uda, parabolic, path, horn, dipole and mono pole antenna.
2. To study and verify the communication using wave-guides.
3. To study and verify VSWR for a traveling wave.
2. To study Satellite Communication using trainer kit.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE62L	**Microcontrollers and Embedded Systems Lab**	2	1

List of Experiments

1. Interface 8051 microcontroller with 8 LEDS and write a program to flash these LEDs.
2. Interface 8051 microcontroller with Eight Keys and write a program that will scan these Eight Keys and Display its Binary code on LEDs.
3. Interface 8051 microcontroller with an LCD and write a program to display a message on the first and 2nd line of LCD.
4. Interface 8051 microcontroller with a seven-segment display and display a message "1234" on the seven-segment display.
5. Write a program for energizing the Two DIP relays interfaced to 8051 microcontroller board.
6. Write a program to demonstrate Opto-isolated inputs on 8051 board.
7. Interface 8051 microcontroller with a stepper motor and write a program to move the motor first clockwise by 20 steps and then anticlockwise by 20 steps and test on the board.
8. Interface 8051 microcontroller with ADC chip and the display digital value on an LCD.
9. Write a program to demonstrate DAC by generating a RAMP signal.
10. Write a program to store data in the EEPROM (24C02) provided on the 8051 board for permanent storage of data.
11. Write a program to read data from the EEPROM (24C02) provided on the 8051 board for permanent storage of data.

Note: Programs for above experiments should be implemented both using Assembly and C programs instructions.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE64L	**Electronic Measurement & Instrumentation Lab**	2	1

List of Experiments

1. Obtain Characteristics of LVDT
2. Obtain Characteristics of Strain gauge
3. Obtain Characteristics of thermocouple
4. Obtain Characteristics of thermistor
5. Obtain Characteristics of RTD transducer
6. PLC programs based on the available kits in the Lab

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE65L	**VLSI Design Lab**	2	1

List of Experiments

1. To find VI characteristics of a MOSFET.
2. To verify the operation of MOSFET as a Switch.
3. To verify the operation of MOSFET as a linear resistor.
4. To verify the Voltage transfer characteristics of CMOS Inverter.
5. To design and verify the operation of CMOS based basic(NOT,AND,OR) and universal gates(NAND, NOR).
6. To design and verify 2x1 multiplexer/ de-multiplexer using CMOS Logic.
7. To design and verify 2x1 multiplexer/ de-multiplexer using transmission gates.
8. To design and verify RAM Cell using CMOS cross coupled inverters.
9. To design/generate layout of CMOS based NOT, NAND and NOR gates.

Note: Simulators used may include ADS, Cadence, Mentor Graphics based on availability.

Course No.	Subject	Teaching Periods	Credits
		P	
PSIECE66	**SEMINAR**	2	1

DESCRIPTION:

The Technical Seminar shall be carried out as part of the 6th semester curriculum and is important for the partial fulfillment for the award of the Bachelors Degree in Engineering. The main objectives of conducting the seminar are:

1. To encourage the students to study advanced engineering developments
2. To prepare and present technical reports.
3. To encourage the students to use various teaching aids such as over head projectors, power point presentation and demonstrative models.

METHOD OF EVALUATION:

During the seminar session each student is expected to prepare and present a topic on engineering/ technology, for a duration of about 15 to 20 minutes in front of the faculty committee for seminars and the students from the 6th semester (preferably from other semesters also). Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

7^{th} Semester

Course No.	Subject	Teaching Periods		Credits
		L	T	
ESCECE71	**Power Electronics**	2	1	3

Section	Course contents	Hours
1.	Review of power semiconductor switching devices, Diode, Thyristors, MOSFET, IGBT, Characteristics and applications	7
2.	Introduction to Turn-ON/Turn-OFF mechanism of switching devices, Gate-drive circuits, Switching-aid circuits, protection, Heat sink design	7
3.	Single phase rectifiers (uncontrolled, semi-controlled, controlled) with passive loads, Performance analysis, Applications	8
4.	Three-phase rectifiers (uncontrolled, semi-controlled, controlled) with passive loads, Performance analysis, Applications	7
5.	Single-phase inverter: principle of operation, single phase bridge inverter, voltage Control in inverters and harmonic reduction using PWM strategies, Applications	8
6.	Three-phase inverters: 180 degree conduction and 120 degree conduction, voltage Control in inverters and harmonic reduction using PWM strategies	8
7.	Introduction to DC-DC converters; buck ,boost and buck-boost converters, Applications	5
TOTAL HOURS FOR THE COURSE		**50**

References

1. Fundamental of Power Electronics: Robert Erickson, D.Maksimovic
2. Power Electronics, Circuits, Devices and Applications: Muhammad H. Rashid
3. Power Electronic, Devices, Applications, and Passive Components: Barry W. Williams
4. Power Electronics-converters, Applications, and Design: NedMohan, Tore.M.Undel and, William P. Robbins

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE72	**Data Communication**	2	1	3

Section	Course contents	Hours
1	***Introduction*** **-** Data Communications, The OSI Model, TCP/IP Protocol Suite	3
2	***(PHYSICAL LAYER and MEDIA)_Data and Signals*** **-** Analog And Digital, Periodic Analog Signals, Digital Signals, Transmission Impairment, Data Rate Limits, Performance	5
3	***Digital Transmission*** **-** Digital-To-Digital Conversion, Analog-To-Digital Conversion, Transmission Modes	6
4	***Analog Transmission*** **-** Digital-To-Analog Conversion, Analog-To-Analog Conversion	6
5	***Bandwidth Utilization: Multiplexing and Spreading*** **–** Multiplexing, Spread Spectrum	4
6	***Transmission Media*** **-** Guided Media, Unguided Media	2
7	***(DATA LINK LAYER)_Error Detection and Correction*** **–** Introduction, Block Coding, Linear Block Codes, Cyclic Codes, Checksum	5
8	***Data Link Control*** **–** Framing, Flow And Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Point-To-Point Protocol	5
9	***Multiple Access*** **–** Random Access, Controlled Access, Channelization	5
10	***Wired LANs: Ethernet*** **-** IEEE Standards , Standard Ethernet , Changes In The Standard, Fast Ethernet, Gigabit Ethernet	2
11	***Wireless LANs*** **-** IEEE 802.11, Bluetooth	2
12	***Connecting LANs, Backbone Networks, and Virtual LANs*** **-** Connecting Devices, Backbone Networks, Virtual LANs	3
13	***Wireless WANs: Cellular Telephone and Satellite Networks*** **-** Cellular Telephony, Satellite Networks	2
TOTAL HOURS FOR THE COURSE		**50**

References

1. Data Communications and Networking by Behrouz A. Forouzan, Tata McGraw Hill
2. Computer Networks by Andrew S. Tanenbaum, Pearson Education
3. Data Communications and Computer Networks by W. Stallings

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE73	**Microwave Engineering**	3	1	4

S. No.	Course contents	Hours
1	Microwave Semiconductor Devices: Classification of Microwave Devices	2
2	Point Contact diode; Tunnel Diode	3
3	Gunn Diode, two valley structures, mode of operation, circuit realization	3
4	IMPATT Diode, circuit realization	2
5	PIN diode, basic principles of operation equivalent circuit, and application as switch, modulator and Phase shifter	4
6	Microwave Components: Microwave Hybrid Circuits: Waveguide tee: E-plane tee, H-plane tee, Magic tee, hybrid rings (rat-race circuits)	5
7	Directional Couplers, S-Matrix of direction Coupler. Circulators and isolators	4
8	Microwave Amplifiers & Oscillators : Microwave tubes: lead inductance and Inter electrode capacitive effects Transient angle effect, Gain bandwidth Limitation	3
9	Klystrons: Multi-cavity Klystron and Reflex Klystron	3
10	Gunn Oscillator, Magnetron oscillator	3
11.	Transmission Lines Transmission Line equations and solutions,	3
12.	Characteristic impedance and propagation constant	3
13.	Reflection and transmission coefficients, SWR	3
14.	Open and short circuit lines- their use as circuit elements at UHF	3
15.	Line impedance and admittance	2
16.	Smith Chart	2
17.	Impedance Matching	2
TOTAL HOURS FOR THE COURSE		**52**

References

1. Liao, S. Y, Microwave Devices & Circuits, PHI
2. David Pozar, Microwave Engineering, John Wiley
3. R E Collin: Foundations for Microwave Engineering, Mc Graw Hill
4. Skolnik: Introduction to Radar Engineering, Mc Graw Hill

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE74	**Computer Organization and Architecture**	2	1	3

Section	Course contents	Hours
1	Computer organization and architecture, Computer Level Hierarchy, Evolution of Computers, Von-Neumann Architecture, Structure and Components of Computers	6
2	Computer Functions, Instruction Execution and Instruction Cycle State Diagrams	4
3	Computer Buses, Bus Interconnection and Hierarchy, Elements of Bus Design, Bus Arbitration and Timings	4
4	Basic CPU equation. Measuring Performance – MIPS, FLOPS, CPI/IPC, Benchmark, Speedup, Amdahl's and Moore's Laws	4
5	Instructions and Instruction Set–Characteristics, Types, Functions, Execution, Representation, Format, Addressing Modes, CPU Register Organization	4
6	Computer arithmetic logic design, fast adders, multiplication, Booth's algorithm, fast multiplication, integer division, ALU– Fixed and Floating point ALU Organization, floating point arithmetic	6
7	Control Unit – Functional Requirements, Structure, Control Signals, hardwire and Micro-programmed Wilkes Control unit, Microinstructions and its formats, Control Memory	6
8	Introduction to Pipelining and Parallel Processing	2
9	Memory Hierarchy, types and Characteristics, Primary Memory- Types, Working, Chip Organization, Expansion	2
10	Cache Memory- Mapping Schemes, Replacement Policies, Hit and Miss, Write policies, Coherence, Virtual memory– Overlays, Paging, Segmentation and Fragmentation	6
11	Input-Output organization– Peripheral devices, I/O modules, Input-output interface, Modes of transfer - Programmed I/O, Interrupt-driven I/O, Direct Memory access, I/O processor, Data Communication processor	6
TOTAL HOURS FOR THE COURSE		**50**

References

1. William Stalling: Computer organization and architecture, Latest Edition
2. John P. Hayes: Computer Architecture and Organization, Latest Edition
3. Computer Organization by Hamachar
4. Computer Organization & Architecture by M. M. Mao

Course No.	Subject	Teaching Periods	Credits
		P	
ESCECE71L	**Power Electronics Lab**	2	1

List of Experiments

1: To do the following:

(a) To obtain V-I Characteristics of an SCR.

(b) To obtain V-I Characteristics of a TRIAC.

2: To obtain the Static Emitter Characteristic sofa UJT.

3: To study the Line-synchronized UJT Relaxation Oscillator as a triggering agent for a thyristor and plot load voltage v/s firing angle.

4: To study various firing schemes of an SCR and draw the traces for various waveforms:

(a) Resistance Triggering Technique,

(b)R-C Triggering Technique,

(c)Linear Firing Scheme,

(d)Inverse Cosine Firing Scheme.

5: To study a Single-Phase Half-Wave Converter and plot Source voltage, Load voltage and load current for R and R-L loads.

6: To study a Single-Phase Semi-Converter and plot Source voltage, Source current, Load voltage and load current for R, R-L and Motor Loads.

7: To study a Single-Phase Full-Converter and plot Source voltage, Source current, Load voltage and load current for R, R-L and Motor Loads.

8: To study a Three-Phase Semi-Converter and plot Source voltage, Source current, Load voltage and load current for R, R-Land Motor Loads.

9: To study a Three-Phase Full-Converter and plot Source voltage, Source current, Load voltage and load current for R, R-Land Motor Loads.

10: To study a Single-Phase Dual Converter on Motor Load.

11: To study a DC-DC Buck Converter (Step-Down Chopper)for R, R-L and DC Motor Load and plot Load voltage Vs. Duty Ratio.

12: To study a Single-Phase Voltage Source Inverter on Rand R-L Loads.

13: To study a Three-Phase Voltage Source Inverter on R and R-L Loads.

14: To study a Single-Phase PWM Voltage Source Inverter on R and R-L Loads and plot Load voltage Vs. Modulation index.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE72L	**Data Communication Lab**	2	1

List of Experiments

1. Perform pulse coded modulation for analog to digital conversion. Analyze bandwidth requirement, data rate generation, synchronous and asynchronous mode of transmission.
2. Perform bandwidth utilization technique time division multiplexing.
3. Perform various line coding formats and compare transmission characteristic of each formats.
4. Perform digital carrier modulation techniques used in wireless communication.
5. Perform amplitude modulation and demodulation.
6. Perform serial data communication between two data terminal equipment using optical link.
7. Perform digital data transfer through RF transmitter and receiver.
8. Demonstration of different types of cables used in data communication.
9. Perform Installation of LAN and troubleshooting of frequently occurred problems.
10. Create and test wireless sensor networks.
11. To study various aspects of data communication by field visit at data center.
12. Perform data communication using IR.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE73L	**Microwave Engineering Lab**	2	1

List of Experiments

1. Study of Microwave components and Instruments.
2. To plot and study the V-I characteristics of a Gunn diode.
3. Tuning of Gunn Oscillator.
4. To study the characteristics of Reflex Klystron.
5. Tuning of Klystron Oscillator.
6. To study the Characteristics of Detector.
7. To measure the Frequency using direct reading frequency meter and compare it with indirect frequency meter.
8. To study the properties of E- and H-plane waveguide tee junctions and to determine isolations, coupling coefficients and input VSWR.
9. Study of transmission lines concepts using trainer Kit.

Course No.	Subject	Teaching Periods	Credits
		P	
PSIECE76	**Project (Phase-I)**	2	1

DESCRIPTION:

The Project work shall be carried out by a group of students. The maximum number of students in a group can be four (4). In the project work, a student shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general and humanity in particular. Supervisor/mentor will be assigned to each student in the beginning of the 7th semester of their course. The Project Phase-1 can encompass any of the following.

1. A full-fledged mini project that needs to be submitted in totality at the end of 7th semester. The deliverables include: The working prototype of the project, Project Report and PPT presentation.
2. A part of the major project (Project-phase-II).The Deliverables include the working modules of the project, the partial project completion Report and the PPT presentation.
3. A Part of the major Research based project (Project-phase-II).The deliverables include partial Project completion report containing (Problem Definition, Literature Survey, Design methodology and Simulations), the working modules (H/W or S/W) and PPT presentation.

METHOD OF EVALUATION:

The Project Phase-I will be Evaluated at the end of the 7th Semester. The students need to present themselves before an examination committee (Internal + External) with the working modules of the project.

In case of the students who have developed a full-fledged mini project. The evaluation will be final.

In case of the students who have developed project as part of the Major project will be evaluated for the 7th semester. In Case the examination committee is not satisfied with the work of the team, they will have full authority to cancel the project for further development in the 8th semester.

The Evaluation committee must minimally comprise of the External Examiner, Head of the Department, Internal project guides and Project Faculty Incharge.

8th Semester

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE81	**Wireless Communication**	2	1	3

Section	Course contents	Hours
1	**Introduction to Cellular Mobile Systems:** A basic cellular system, performance criteria, Uniqueness of mobile radio environment, operation of cellular systems, planning a cellular system, Analog & digital cellular systems.	4
2	**Elements of Cellular Radio Systems Design:** General description of the problem, Concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an omnidirectional antenna system, cell splitting, consideration of the components of cellular systems.	7
3	**Cell Coverage for Signal & Traffic:** General introduction, obtaining the mobile point to point mode, Radio propagation characteristics: models for path loss, shadowing and multipath fading Propagation over water or flat open area, foliage loss, propagation nearin distance, long distance propagation, point to point prediction model characteristics, cellsite, antenna heights and signal coverage cells, mobile to mobile propagation.	7
4	**Cell Site Antennas and Mobile Antennas:** Characteristics of antennas, antenna at cell site, mobile antennas, LOS antennas, TDD, FDD.	5
5	**Frequency Management, Channel Assignment and handoff:** Frequency management, fixed channel assignment, non-fixed channel assignment, traffic & channel assignment, handoff, types of hand off and their characteristics, hand off analysis, dropped call rates & their evaluation.	7
6	**Multiple access techniques used in mobile wireless communications**: FDMA/TDMA, CDMA. FDM / TDM Cellular systems, Cellular CDMA, comparison of FDM / TDM systems and Cellular CDMA.	7
7	Capacity, soft capacity, erlang capacity and their usage.	3
8	**Global System for Mobile Communication (GSM) system overview**: GSM Architecture, Mobility management, Network signaling, Frequency allocation and control, Base System and Master System, GSM, DCS1800, Various value added services.	8
9	Introduction to GPRS, EDGE, UMTS, HSPDA, HSUPA, LTE.	4
TOTAL HOURS FOR THE COURSE		**52**

References

1. Wireless Communication; Principles and Practice; T. S. Rappaport
2. Principles of Mobile Communication, G. L Stuber Kluwer Academic,
3. Wireless and Digital Communications; Dr. Kamil o Feher (PHI)
4. Mobile Communication HandBook; IEEE Press
5. Mobile Communication Engineering– Theory & Applications; TMH

Course No.	Subject	Teaching Periods		Credits
		L	T	
PCCECE82	**Computer Network & Security**	2	1	3

Section	Course Contents	Hours
1	Introduction- Networks, The Internet, Protocols And Standards	4
2	Network Models - Layered Tasks, The OSI Model, Layers In The OSI Model, TCP/IP Protocol Suite, Addressing	4
3	Switching - Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks, Structure of a Switch	3
4	Using Telephone and Cable Networks for Data Transmission	3
5	NETWORK LAYER, Logical Addressing	5
6	Network Layer: Internet Protocol - Internetworking: Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network, IPv4, Datagram, Fragmentation, Checksum, Options, IPv6, Advantages, Packet Format, Extension Headers , Transition From IPv4 to IPv6:Dual Stack, Tunneling, Header Translation	6
7	Network Layer: Address Mapping, Error Reporting, and Multicasting - Address Mapping: Mapping Logical to Physical Address: ARP, Mapping Physical to Logical Address: RARP, BOOTP, and DHCP, ICMP, IGMP, ICMPv6	6
8	Network Layer: Delivery, Forwarding, and Routing – Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols	6
9	(TRANSPORT LAYER)_Process-to-Process Delivery: UDP, TCP, and SCTP - Process-To-Process Delivery, User Datagram Protocol (UDP): Well-Known Ports for UDP, User Datagram, Checksum, UDP Operation, Use of UDP, TCP: TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, Error Control, Congestion Control, SCTP: SCTP Services, SCTP Features, Packet Format, An SCTP Association, Flow Control, Error Control, Congestion Control	3
10	(APPLICATION LAYER)_Domain Name System - Name Space, Domain Name Space, Distribution Of Name Space, DNS In The Internet, Resolution, DNS Messages, Types of Records, Registrars, Dynamic Domain Name System (DDNS), Encapsulation	2
11	Introduction: Need of security, Security attacks, services and mechanisms, Network security model	4
12	Network Security: Firewalls, IP Security, Virtual Private Networks and Intrusion Detection, Web Security-SSL and TLS	4
TOTAL HOURS FOR THE COURSE		**50**

References

1. Data Communications and Networking by Behrouz A. Forouzan, Tata McGraw Hill
2. Computer Networks by Andrew S. Tanenbaum, Pearson Education
3. Data Communications and Computer Networks by W. Stallings
4. Cryptography and Network Security by Forouzan, PHI 4.

Course No.	Subject	Teaching Periods		Credits
		L	T	
BSCECE83	**Organization of Engineering Systems & HR Management**	2	1	3

Section	Course contents	Hours
1	Introduction to the subject and the course	1
2	**Module A: Basics of organizations and human resources management** Understanding organizations: nature and functions, Concerns of organizing engineering business and systems, Structure and process issues in running organizations, Design issues in running organizations, Operating organizations	12
3	**Module B: Effectiveness and performance** Cybernetics and systems framework, Socio-technical systems, Dealing with efficiency and excellence, Man-machine relationship, Longitudinal Thinking	12
4	**Module C: Human elements of functioning organizations** Concerns of recruitment, selection, skill formation and redeployment, Developing teams and leadership, Understanding motivation, Elements of human resources planning, Indian Industrial Law and managing industrial relations	13
TOTAL HOURS FOR THE COURSE		**38**

References

1. Beer, Stafford(1975) *The Heart of Enterprise*, Preguin Press, London
2. Coulson-Thomas Colin,((1997) *The Future of Organisation: Achieving Excellence through Business Transformation* ,Kogen Page
3. Constantin Virgil Negoita (1992). *Cybernetics and Applied Systems*, CRS Press, USA
4. Dimitris N. Chorafas (2011). *Business, Marketing, and Management Principles for IT and Engineering*, Taylor and Francis,USA
5. Gautam Vinayshil(1988) Comparative Manpower Planning Practices-Select Indian Experiences, National Publishing House, New Delhi

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE81L	**Wireless Communication Lab**	2	1

List of Experiments

1. Study of Dual SIM Phone.
2. Study of GSM.
3. Study of 3G.
4. Study of CDMA.
5. Study of Bluetooth

Note: Simulators used include following, where ever applicable OPNET, NS2, NS3.

Course No.	Subject	Teaching Periods	Credits
		P	
PCCECE82L	**Computer Network & Security Lab**	2	1

List of Experiments

1. Study of different types of Network cables and practically implement the cross-wired cable and straight through cable using clamping tool.
2. Install and Configure Wired and Wireless NIC and transfer files between systems in LAN and Wireless LAN.
3. Install and configure Network Devices: HUB, Switch and Routers.
4. Connect the computers in Local Area Network.
5. Configure Host IP, Subnet Mask and Default Gateway in a System in LAN (TCP/IP Configuration).
6. Establish Peer to Peer network connection using two systems using Switch and Router in a LAN.
7. Configure Internet connection and use IPCONFIG,PING / Tracer and Net stat utilities to debug the network issues.
8. Transfer files between systems in LAN using FTP Configuration, install Print server in a LAN and share the printer in a network.
9. Study of basic network command and Network configuration commands.
10. Configure Network topologies using packet tracer software.
11. Demonstrate firewalls and Intrusion Detection System (IDS)

Course No.	Subject	Teaching Periods	Credits
		P	
PSIECE84	**Project (Phase-II)**	8	4

DESCRIPTION:

The Project work shall be carried out by a group of students .The maximum number of students in a group can be four (4). In the project work student shall choose a specific topic/area for the project. The selected areas shall encompass recent and emerging trends in technologies that prove beneficial for society in general and humanity in particular. Supervisor/mentor will be assigned to each student in the beginning of the 8th semester of their course. The Project Phase-II can encompass any of the following.

1. A fresh project to be chosen after the evaluation of 7th semester minor project is over .The deliverables include The working prototype of the project, Project Report and PPT presentation to be submitted at the end of the 8th semester.
2. The Remaining part of the 8th semester project (Project-phase-II), that the students had chosen as full project at the seventh semester level. The students must have completed a part of it, duly evaluated by the examination committee at the 7th semester level. The uptake of the project is subjected to the condition that the evaluation committee gives a nod for further uptake of the project. The deliverables include The working prototype of the project, Project Report and PPT presentation to be submitted at the end of the 8th semester.

3. The Remaining Part of the major Research based project (Project-phase-II) that the students had chosen as full project at the seventh semester level. The students must have completed a part of it, (as described in the project-Phase-I plan), duly evaluated by the examination committee at the 7th semester level. The uptake of the project is subjected to the condition that the evaluation committee gives a nod for further uptake of the project. The deliverables include: The working prototype of the project, Project Report and PPT presentation to be submitted at the end of the 8th semester.

METHOD OF EVALUATION:

The Project Phase-II will be evaluated at the end of the 8th Semester. The students need to present themselves before an examination committee (Internal + External) with the working prototype/Software of the project, The Thesis report and the power point presentation of the project.

The Evaluation committee must minimally comprise of the External Examiner, Head of the Department, Internal project guides and Project Faculty in-charge.

Course No.	Subject	Teaching Periods	Credits
		P	
PSIECE85	**Professional Viva**	0	1

DESCRIPTION:

A viva voce is an oral test, which literally translated means 'with the living voice'. It's a focused discussion giving you the opportunity to defend your Professional and Technical Abilities in front of a panel of academic experts. The Technical abilities include the core concepts and the skills gained by the student during the process of the four (4) Years of the Degree. While students need to be sure that this isn't a memory test, it is still important to gain a good understanding of the knowledge about your field of study. The professional abilities include the way a student presents himself in-front of an interview panel.

METHOD OF EVALUATION:

The Professional Viva is conducted at the end of the 8^{th} Semester. The students need to present themselves before an examination committee (Internal + External) with professional/Formal attire.
The evaluation committee evaluates the students on the basis of subjective knowledge and soft skills.
The Evaluation committee must minimally comprise of the External Examiner, Head of the Department, Internal project guides and Faculty in-charge.

Course No.	Subject	Teaching Periods	Credits
		P	
PSIECE86	**Industrial Internship**	0	1

DESCRIPTION:

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical/ managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.

The Framework for Internship is as per AICTE Guidelines.

Schedule	Duration	Activities
During Vacation after 3rd Semester	4-6 weeks	Industrial/Govt./NGO/ MSME/ Rural Internship/ Innovation/ Entrepreneurship/ Private Enterprise/ Skill development Inst.
During Vacation after 5th Semester	4-6 weeks	Industrial/Govt./NGO/ MSME/ Rural Internship/ Innovation/ Entrepreneurship/ Private Enterprise/ Skill development Inst.
During Vacation after 7th Semester	4-6 weeks	Industrial/Govt./NGO/ MSME/ Rural Internship/ Innovation/ Entrepreneurship/ Private Enterprise/ Skill development Inst.

EVALUATION:

The student can go for more than one internship/ Skill development course in his/her curriculum. But for the necessary evaluation, the student needs to submit one of his/ her best Internship reports and certificates to the college. The evaluation will be done through Seminar Presentation/ Viva-Voce.

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department on the basis of:

1. Quality of content presented
2. Proper planning for presentation.
3. Effectiveness of presentation.
4. Depth of knowledge and skills.
5. Attendance record, daily diary.

The Evaluation committee must minimally comprise of the External Examiner, Head of the Department, Senior Faculty and T&P Faculty Incharge.

ELECTIVES
(DETAILED SYLLABUS)

Professional Elective Courses -I

PEC1ECE601E

SOLID-STATE DEVICES

UNIT I:

Crystal Structure: Fundamental concepts, Closed packed structures, Crystal systems, Crystallographic planes and directions, Miller indices, Point defects. Free electron Theory, classification of solids into conductors, Semiconductors and insulators, Effective mass.

UNIT II:

Dielectric Properties: Dielectric materials, Polarization mechanisms, Dipole moment, Dielectric strength, Methods for producing polarization, Application of dielectric materials. Magnetic Properties: Basic concepts, Soft and hard magnetic materials, Ferrites Selection techniques for applications, Magnetic recording, Magnetic memories. Optical Properties: Index of refraction, Damping constant, characteristic penetration depth and absorbance, Reflectivity and transmissivity, Atomic theory of the optical properties, Optical storage devices.

UNIT III:

Device Materials: Materials for resistors, capacitors and inductors. Superconductivity: Properties of superconductors, Applications of superconductors. Semiconductor Materials: Intrinsic and extrinsic materials, Electron and hole concentration sate equilibrium, Temperature dependence of carrier concentrations, Conductivity and mobility.

UNIT IV:

Effect of temperature and doping on mobility, Direct and indirect recombination of electron and holes, Diffusion and drift of carriers, Diffusion length, Contact potential. Hall Effect and its Applications. Si, Ge, GaAs and other binary semiconductors.

References

1. HummelRE,“ElectronicPropertiesofMaterials”,NarosaPublishingHouse.
2. William D Callister, Jr “Materials Science and Engineering”, John Wiley and Sons, Inc.
3. Dekker A J “Solid State Physics”, Mac Milan, India Limited, Madras.
4. Pillai S O “Solid State Physics”, New Age International Publishers.
5. VanVlack L H “Elements of Material Science and Engineering”, Addison Wesley Publishers
6. Streetman BG and Banerjee S “Solid State Electron Devices”, Prentice Hall of India.

PEC1ECE602E

ADVANCED EMBEDDED SYSTEMS PROTOTYPING

UNIT I

Introduction to open source embedded systems: Components of embedded system. Advantages and applications of embedded systems. Examples of real time embedded systems and how they are manufactured industry ready. Different Microcontroller Architectures (CISC, RISC, ARISC). Internal Resources & Hardware Chips in Details. History of AVR Microcontrollers and Features. Memory Architectures (RAM/ROM).

UNIT II

Learning Arduino Platform: Introduction to ARDUINO, ARDUINO History and Family. ARDUINO flavours, ARDUINO Architecture, Basic ARDUINO KIT Circuits, Programming in Embedded-C, Concepts of C language. Installing the Integrated Development Environment (IDE)-Setting up the Arduino Board-Using the Integrated Development Environment (IDE) to prepare an Arduino Sketch-Uploading and Running the Blink Sketch.

UNIT III

Serial Communications: Introduction to Serial communications, Synchronous and asynchronous Serial communication, UART and Serial Teletypes and standards. Different types of protocol converter IC's used in serial communication interfaces. Anatomy of PC and microcontroller based Serial communications.

UNIT IV

Digital and Analog Input/Output: Introduction to digital inputs and outputs, Types of Digital Inputs and outputs, Introduction to Digital Sensors ,signal conditioning the outputs of sensors for digital input operation, Voltage and Current Specifications of Digital outputs, Signal conditioning of Digital outputs. Types of Switches and their interfacing with microcontrollers, Introduction to AD and DA converters, inbuilt AD, DA converters in microcontrollers. Introduction to PWM and inertial Loads.

References

1. Arduino Cookbook by Michael Margolis. Orielly Media Publications
2. Exploring Arduino: Tools & Techniques by Jeremy Blum. Wiley Publications

PEC1ECE603E

ADVANCED MICROPROCESSORS

UNIT I
Introduction to 8086 Microprocessor Architecture, features and signals.

UNIT II
80286- A Mircroprocessor with Memory Management & Protection. Salient features of 80286, Internal architecture of 80286, Signal descriptions of 80286, Real addressing mode, Protected virtual address mode, Privilege, Protection, Special operation, 80286 Bus interface, Basic Bus operation, Fetch cycles of 80286, 80286 Minimum system configuration, Interfacing memory and I/O devices with 80286, Priority of bus use by 80286, Bus Hold and HLDA sequence, Interrupt acknowledge sequence, Instruction set features.

UNIT III
80386, 80486 – THE 32 Bit Processor: Salient feature of 80386, Architecture and signal description of 80386, Register organization of 80386, Addressing modes, Coprocessor 80387.

UNIT IV
An Introduction to the Pentium Microprocessor.

UNIT V
Interfacing and Programmable Devices for 8086 Based systems, Interfacing of Co-Processor, Switches, LED's, Analog to Digital Converter, Digital To Analog Convertor, DC and Stepper Motor, Seven segment and LCD display with 8086.

References

1. A. K. Ray & K. M. Bhurchandi- Advanced Microprocessor and Peripherals- Tata Mcgraw Hill.
2. B. P. Singh – Advanced Microprocessor and Microcontrollers- New Age International.
3. Brey, Barry B – Intel Microprocessor.
4. D. V. Hall – Micro process Interfacing.
5. "An Introduction to the Intel Family of Microprocessor," by J. L. Antonacos.

PEC1ECE604E

POWER SYSTEMS

UNIT I

DC and AC Distribution System: Introduction to a power system (an overall view), distribution systems Feeder, distribution, service. Mains classification, connection schemes, various types of DC and AC distributors, voltage drop calculations.

UNIT II

Overhead AC Transmission lines: Line Parameters, Types of conductors. Aluminum Core Steel Reinforced (ACSR) etc. Stranding, bundling of conductors. Resistance calculations, skin effect, proximity effect, Inductance and capacitance and capacitance of single Phase, 3 phase, single circuit and double circuit lines.

UNIT III

Representations and performance of short medium and long lines, ABCD constants, Surge impedance, Feranti effect, Power flow through a transmission lines.

UNIT IV

Insulators for overhead lines: Materials for insulators, types of insulators, potential distribution over a string of suspension insulators, methods for equalizing the potential Interference of power lines with communication circuits.

UNIT V

Electrostatic and electromagnetic effect. Corona: Visual and critical disruptive voltage, conditions effecting corona, former loss due to corona, Practical consideration, Mechanical design of transmission lines. Sag and tension calculations.

References

1. Elements of Power System Analysis by W. D. Stevenson
2. Transmission & Distribution of Electrical Energy by H. Cotton & Barber
3. Power System Engg. by Nagrath & Kothari
4. Electrical Power Systems by C. L. Wadwa

PEC1ECE605E

SYSTEM DESIGN

UNIT I

Introduction: Understanding a system, Components of a system: inputs, internal processes, outputs, feedback, assessment and evaluation, learning, Ways of Thinking: Logical Thinking, Causal Thinking, Reductionist Thinking, Holistic Thinking.

UNIT II

Interconnect: The Wire, Interconnect Parameter: Capacitance, Resistance, and Inductance, Electrical Wire Models, SPICE Wire Models, Signal Integrity and High Speed Behavior Of Interconnects: Ringing, Cross Talk and Ground Bounce.

UNIT III

System Hardware decomposition: Data Path And Control Path, Register Transfer Level Description, Control Flow And Data Flow Pipelines with special reference to digital filters, Communication Between Subsystems, Dead Lock and Live Lock problems.

UNIT IV

Subsystem design: HDL based design flow for system design, Introduction to Verilog: various components of Verilog code, Design of combinational circuits, sequential circuits, barrel shifter register, multi-bit adders, multipliers.

UNIT V

MPSoC as System Design Paradigm: Introduction to MPSoC, Need for MPSoC Architectures, Interconnection requirements of sophisticated systems, Network-on-Chip as a interconnection solution, Problems of traditional interconnection techniques, Arbiter for NoC.

References

1) Rabaey Jan M., Chandrakasan Anantha and Borivoje Nikolic, "Digital Integrated Circuits (Design Perspective)", Prentice Hall of India, 2nd Ed., 2003.
2) Laung-Terng Wang, Cheng-Wen Wu and Xiaoqing Wen,"VLSI Test principles And Architectures Design For Testability", Morgan Kaufmann Publishers, 1st Ed., 2006.

PEC1ECE606E

MATHEMATICS FOR MACHINE LEARNING

UNIT I

Linear Algebra: Vectors**,** Modulus & inner product, Cosine & Dot product of vectors, Projection, Basis, changing basis, vector space, and linear independence of a set of vectors, Applications of changing basis, Linear dependency of a set of vectors, Matrices, vectors, and solving simultaneous equation problems, Types of matrix transformation, Composition or combination of matrix transformations, Gaussian elimination, Inverse matrix, Determinants and inverse, Identifying special matrices, eigenvalues and eigenvectors, Calculating eigenvectors, Visualising Matrices and Eigen

UNIT II

Multivariate Calculus: Functions, Definition of a derivative, Differentiation examples & special cases, Product rule, Chain rule, Matching functions visually, Matching the graph of a function to the graph of its derivative, Let's differentiate some functions, Practicing the product rule, Practicing the chain rule, Differentiate with respect to anything, The Jacobian, Jacobian applied, The Sandpit, The Hessian, Practicing partial differentiation, Calculating the Jacobian, Bigger Jacobians, Calculating Hessians, Multivariate chain rule, Simple neural networks, Training Neural Networks, Building approximate functions, Power series, Power series derivation, Power series details, Linearisation, Multivariate Taylor

UNIT III

Statistics: Exploring one-variable quantitative data: Displaying and describing, exploring one-variable quantitative data: Summary statistics, exploring one-variable quantitative data: Percentiles, z-scores, and the normal distribution, exploring two-variable quantitative data, collecting data

UNIT IV

Probability: Introduction to Probability, Conditional probability and independent events, Visualization of conditional probabilities and Independence, Bayes's rule, Probability distribution, Binomial distribution, Variance of random variable. Discrete random variables with infinite number of values, Geometric and Poisson distributions, Systems of random variables; properties of expectation and variance, covariance and correlation, Linear transformations of random variables, Probability density function (PDF), Cumulative distribution function (CDF), Properties of CDF, Linking PDF and CDF, Histogram as approximation to a graph of PDF.

References

1. Bayesian Statistics the Fun Way: Understanding Statistics and Probability by Will Kurt published by O'Reilly
2. Think Stats by Allen Downey published by O'Reilly
3. Think Bayes: Bayesian Statistics in Python by Allen Downey published by O'Reilly
4. *Mathematics for Machine Learning* by. Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong. published by Cambridge University Press
5. Linear Algebra and Learning from Data, by Gilbert Strang Wellesley Publishers
6. Highlights of Calculus, by Gilbert Strang Wellesley Publishers2nd Edition

PEC1ECE607E

OPERATIONS RESEARCH

UNIT I

Introduction to OR Modelling Approaches & various Real-life Situations, Linear Programming Problems (LPP), Basic L L P ’s Applications, Various Components of LPP formulation, Solving LPP.

UNIT II

Simultaneous Equations and Graphical Methods, Simplex Method, Duality Theory, Big-M Method, Transportation problems & Assignments Problems.

UNIT III

Network Analysis: Shortest Path, Dijkstra Algorithm, Floyd Algorithms, Maximal Flow Problem ((Ford-Fulkerson), PERT- CPM.

UNIT IV

Queuing Theory: Introduction, Basic Definitions & Notations, Axiomatic Derivation of the Arrival & Departure (Poisson Queue), Poisson Queue Models: M/M/1: ∞/FIFO, M/M/1: N/ FIFO.

References

1. H.A. Taha, “Operations Research”, Macmillan Publishing Company.
2. Hadley G., “Linear Programming”, Narosa Publishers.
3. Mital, “Optimization Methods”, New Age International.
4. Rao, “Engineering Optimization”, New Age International.

Professional Elective Courses - II

PEC2ECE701E

INTRODUCTION TO MACHINE LEARNING

UNIT I

Definition of learning systems. Goals and applications of machine learning. Aspects of developing a learning system: training data, concept representation, function approximation. Linear Regression, Multiple Variable Linear Regression, Logistic Regression, Naive Bayes Classifiers, k-NN Classification

UNIT II

Neurons and biological motivation. Linear threshold units. Perceptron's: representational limitation and gradient descent training. Multilayer networks and backpropagation. Hidden layers and constructing intermediate, distributed representations. Overfitting, learning network structure, recurrent networks.

UNIT III

Maximum margin linear separators. Quadratic programming solution to finding maximum margin separators. Kernels for learning non-linear functions. Decision Trees, Random Forest, Using committees of multiple hypotheses. Bagging, boosting, and Active learning with ensembles.

UNIT IV

Probability theory and Bayes rule. Naive Bayes learning algorithm. Parameter smoothing. Generative vs. discriminative training. Logistic regression. Bayes nets and Markov nets for representing dependencies. Constructing explicit generalizations versus comparing to past specific examples. k-Nearest-neighbor algorithm. Case-based learning.

UNIT V

Learning from unclassified data. Clustering. Hierarchical Clustering. k-means clustering. Dimensionality reduction (PCA), Expectation maximization algorithm (EM) for soft clustering. Semi-supervised learning with EM using labelled and unlabelled.

UNIT VI

Feature engineering Model selection and tuning Model performance measures K fold cross-validation, Regularising Linear models ML pipeline Bootstrap sampling Grid search Cross Validation,

References

1. Introduction to Machine Learning with Python by Andreas C. Muller & Sarah Guido O'Reilly

2. Hands on Machine Learning with Scikit-Learn and Tensor Flow by Aurélien Géron O'Reilly

3. Python Machine Learning for Beginners: Handbook for Machine Learning, Deep Learning and Neural Networks Using Python, Scikit-Learn and TensorFlow by Sanders, Finn

PEC2ECE702E

INTRODUCTION TO MACHINE LEARNING LAB

List of Experiments

1. Basic concepts of object programming in Python A short journey from procedural to object approach Properties Methods Inheritance - one of object programming foundations Exceptions once again Generators and closures Processing files Working with real files

2. Introduction to Python Packages NumPy, Pandas, Matplotlib, Seaborn, ScikitLearn

3. Introduction to traditional Datasets used in Machine Learning

4.Introduction to Classification: Intuitive understanding of the Naïve Bayes Classification, Mathematical Formulation, Implementation of Naïve Bayes Classification using Python-ScikitLearn

5. Introduction to Regression: Intuitive understanding of the Linear Regression, visualizing linear regression, Machine learning applications of linear regression.

PEC2ECE703E

DIGITAL IMAGE PROCESSING

UNIT I
Introduction: imaging and imaging devices. Image sampling and quantization, relationship between pixels and imaging geometry

UNIT II
Image enhancement techniques: Frequency domain, spatial domain, and fuzzy logic based.

UNIT III
Image Segmentation: using edge detection and edge linking techniques, Image threshold and region-oriented segmentation.

UNIT IV
Image representation schemes: Chain codes, polygonal approximation, and signatures.

UNIT V
Shape descriptors: Fourier descriptors. Descriptor using moments. Descriptor using AR and CAR modeling.

UNIT VI
Texture: Introduction to texture, different techniques of texture analysis and their comparison

References

1. Digital Image Processing, R. C. Gonzalez and R. E. Woods
2. Fundamentals of Digital Image Processing by Anil. K. Jain
3. Two-Dimensional Signal and Image Processing by J S Lim

PEC2ECE704E

DIGITAL IMAGE PROCESSING LAB

List of Experiments in MATLAB:

1. Image acquisition, digitization and display
2. Application of edge detection techniques on Images
3. Enhancement of images using histogram equalization, histogram modification, and fuzzy Logic
4. Segmentation of images using thresholding and region growing.

Tools Required: MATLAB Software, Hardware support for DIP toolbox

PEC2ECE705E

OPTICAL COMMUNICATION SYSTEMS

UNIT I

Structures, wave guiding and Fabrication: Nature of Light, Basic optical laws and definitions, Single mode fibers, Graded index fiber structure, Attenuation, Signal Dispersion in fibers. Optical Sources- LEDs, Laser Diodes, Line Coding.

UNIT II

Photo detector Noise, Detector Response Time, Avalanche Multiplication Noise. Optical Receiver Operation- Fundamental receiver operation, Digital receiver performance, Eye diagrams. WDM Concepts and Components- Passive optical Couplers, Isolators and Circulators

UNIT III

Point to point links, power penalties, error control, Coherent detection, Differential Quadrature Phase Shift Keying. Analog Links: Carrier to noise ratio, Multichannel Transmission Techniques, RF over Fiber, Radio over fiber links, Microwave Photonics.

UNIT IV

Network Concepts, Network Topologies, SONET/SDH, High speed lightwave links, Optical add/ Drop Multiplexing, Optical Switching, WDM Network, Passive Optical Networks, IP over DWDM, Optical Ethernet, Mitigation of Transmission Impairments

UNIT V

Measurement standards, Basic Test Equipment, Optical power measurement, Optical fiber characterization, Eye diagram tests, optical time domain reflectometer, optical performance monitoring, optical fiber system performance measurements.

Recommended Books:

1. Gerd Keiser, “Optical Fiber Communications”, 5th Edition, McGraw Hill.
2. Rajeev Ramaswamy and Kumar N Sivarajan, “Optical Networks: A Practical Perspective”, 2nd Ed., 2004, Elsevier Morgan Kaufmann Publishers (An imprint of Elsevier).

Reference Books:

1. John. M. Senior, “Optical Fiber Communications: Principles and Practice”, 2nd Ed, 2000, PE.
2. Harold Kolimbris, “Fiber Optic Communication”, 2nd Ed, 2004, PEI

PEC2ECE706E

OPTICAL COMMUNICATION SYSTEMS LAB

List of Experiments:

1. Measurement of Numerical Aperture.

2. Measurement of Attenuation and Bending Loss.

3. Study of Analog Link and Digital Link.

4. Study of BER and Q-factor estimation in the optical system simulation.

5. EDFA design for DWDM link.

6. Study the Characteristics of a Communication channels AWGN BSC.

7. Analog and Digital Modulation Frequency Modulation and Demodulation QPSK Modulation and Demodulation.

8. Design Conventional Encoder and Decoder.

9. Construction of MUX and DEMUX for WDM systems.

10. Design of Fiber Optic WDM link.

11. Calculate and simulate the attenuation and signal degradation due to intermodal and intramodal distortion.

12. Calculate power coupling losses due to connectors, splices, source output pattern and fiber numerical aperture.

13. Understand, compute and simulate the modes in step index fiber and graded index fiber.

14. Design, implement and test WDM communication system using its basic components.

Tools Required: Optiwave systems, OptSim, Optical Loss test set(OLTS), OTDR, VPIphotonics

PEC2ECE707E

RF CIRCUIT DESIGN

UNIT I:

Importance of Radio Frequency Design, Frequency Spectrum, RF Behavior of Passive, Components, Chip Components and Circuit Board Considerations, RF Circuit Manufacturing Process, Transmission Line Analysis, Example of Transmission Lines, Equivalent Circuit, Representation, Theoretical Foundation, Circuit Parameters for a Parallel-Plate Transmission Line, Summary of Different Transmission Line Configurations, General Transmission Line Equations, Microstrip Transmission Lines, Terminated Lossless Transmission Line, Special Termination Conditions

UNIT II:

The Smith Chart (From Reflection Coefficient to Load Impedance, Impedance Transformation, Admittance Transformation, Parallel Series Connection)

UNIT III:

Single- and Multi-port Networks (Interconnecting networks, Network properties and Applications, Scattering Parameters), Impedance Matching and Tuning

UNIT IV:

Passive RF Components (Coupler Design, Power Combiner and Power Divider: analytical techniques; Multi-band Component Design Techniques), RF Filter Design, Multi-Frequency Design Techniques, Vector Network Analyzer and Simple Calibration Approach, Active RF Components (RF Field Effect Transistors, MOSFETs, HEMTs),

UNIT IV:

Power Amplifier (Biasing and Matching Networks Design Techniques; Stability Considerations, Constant Gain, Constant VSWR Circles, Power Amplifier Topologies, Power Amplifier Operation Modes, Multi-band Matching Techniques for Power Amplifiers)

Recommended Books:

1. RF Circuit Design Theory and Applications, 2nd edition – R. Ludwig and G. Bogdanov, Pearson Economy

Reference Books:

1. Microwave Engineering, 3rd Edition – D. M. Pozar, Wiley
2. Secrets of RF Circuit Design – Joseph Carr, McGraw Hill
3. RF Circuit Design – R. Bowick, Newnes
4. IEEE Xplore, and IEL

PEC2ECE708E

RF CIRCUIT DESIGN LAB

List of Experiments:

Section I: Learning the CAD tool. Introduction to ADS, ADS Design Guides (Smith Chart and its applications)

Section II:

1. Design various transmission line configurations and study their performance and various termination conditions.
2. Design impedance matching networks for different types of load networks
3. Design and Analysis of multi-port networks
4. Design and implementation of a coupler
5. Design and implementation of Power Combiner and Divider
6. ·Design and implementation of different classes of Power Amplifiers.

Tools Required: Advanced Design System

PEC2ECE709E

COMPUTER ARCHITECTURE AND PARALLEL PROCESSING

UNIT I

Review of Basic Computer Organization, Performance Evaluation Methods, Introduction to RISC Instruction Pipeline, Instruction Pipeline and Performance. Pipeline Hazards and Analysis, Branch Prediction, MIPS Pipeline for Multi-Cycle Operations.

UNIT II

Compiler Techniques to Explore Instruction Level Parallelism, Dynamic Scheduling with Tomasulo's Algorithm and Speculative Execution.

UNIT III

Advanced Pipelining and Superscalar Processors, Exploiting Data Level Parallelism: Vector and GPU Architectures, Architectural Simulation using gem5.

UNIT IV

Introduction to Cache Memory, Block Replacement Techniques and Write Strategy, Design Concepts in Cache Memory.

UNIT V

Basic and Advanced Optimization Techniques in Cache Memory, Cache Optimization using gem5, Introduction to DRAM System, DRAM Controllers, and Address Mapping, Secondary Storage Systems, Design Concepts in DRAM and Hard Disk.

UNIT VI

Tiled Chip Multicore Processors (TCMP), Routing Techniques in Network on Chip (NoC), NoC Router Microarchitecture, TCMP, and NoC: Design and Analysis, Future Trends in Computer Architecture Research.

References

1. Computer Architecture - A Quantitative Approach,5th edition, John L. Hennessy, David A. Patterson. 2.
2. Computer Systems Design and Architecture, 2nd Edition, Vincent P. Heuring 3.
3. Computer Organization and Architecture, 6th Edition, William Stallings 4.
4. Advanced Computer Architectures-A Design Space Approach, Dezsosima, Terence Fountain, Peter Kacsuk.

PEC2ECE710E

COMPUTER ARCHITECTURE AND PARALLEL PROCESSING LAB

List of Experiments:

1. Simulating the implementation of the pipeline.
2. Simulating the implementation of instruction level parallelism
3. Simulating the implementation of Vector Architecture
4. Simulating the implementation of GPU architecture
5. Simulating the implementation of super scalar architecture.

Tools Required: GEM5 simulator, MATLAB and GEMS or SIMICS

PEC2ECE711E

NETWORK SECURITY AND CRYPTOGRAPHY

UNIT I

Security: Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques.

UNIT II

Number Theory: Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic.

UNIT III

Private-Key (Symmetric) Cryptography: Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.

UNIT IV

Public-Key (Asymmetric) Cryptography: RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms: MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC.

UNIT V

Authentication and System Security: IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer, Secure Electronic Transaction Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Trusted Systems.

Recommended Books:

1. William Stallings, "Cryptography and Network Security, Principles and Practices", Pearson Education, 3rd Edition.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, "Network Security, Private Communication in a Public World", Prentice Hall, 2 nd Edition.

Reference Books:

1. Christopher M. King, Ertem Osmanoglu, Curtis Dalton, "Security Architecture, Design Deployment and Operations", RSA Pres,
2. Stephen Northcutt, Leny Zeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, "Inside Network Perimeter Security", Pearson Education, 2nd Edition
3. Richard Bejtlich, "The Practice of Network Security Monitoring: Understanding Incident Detection and Response", William Pollock Publisher, 2013.

PEC2ECE712E

NETWORK SECURITY AND CRYPTOGRAPHY LAB

List of Experiments:

1. Write a program to perform encryption and decryption using substitution and transposition cipher.

2. Write a program to implement DES algorithm logic

3. Write a program for evaluation of AES

4. Write a program for evaluation Triple DES

5. Write a program to implement Blowfish algorithm logic

6. Write a program to implement RSA algorithm logic

7. Implement Diffie-Hellman key exchange mechanism using html

8. Write a program to implement Euclid algorithm

9. Calculate the message digest of a text using SHA-1 algorithm

10. Implement the signature scheme digital signature standard

11. Implement electronic mail security

12. Case study on web security requirement

Note:

1. Perform above experiments using C/C++/JAVA/MATLAB/Python.
2. Minimum 10 experiments must be performed from the List.

PEC2ECE713E

MIXED SIGNAL DESIGN

UNIT I

Simple CMOS Current Mirror, Common-Source Amplifier, Source-Follower, Source Degenerated Current Mirrors, cascode Current Mirrors, MOS Differential Pair and Gain Stage Process and temperature independent compensation

UNIT II

Sampling Circuits Performance of Sample-and-Hold Circuits, Testing Sample and Holds, MOS Sample-and-Hold Basics, Examples of CMOS S/H Circuits, Bipolar and BiCMOS Sample-and-Holds. Sample-and-Hold Architectures- Open-loop & closed-loop architectures, open-loop architecture with miller capacitance, multiplexed-input architectures, recycling architecture, switched capacitor architecture.

UNIT III

D/A Converter Architectures Input/output characteristics of an ideal D/A converter, performance metrics of D/A converter, D/A converter in terms of voltage, current, and charge division or multiplication, switching functions to generate an analog output corresponding to a digital input. Resistor-Ladder architectures, Current steering architectures

UNIT IV

A/D Converter Architectures Input/output characteristics and quantization error of an A/D converter, performance metrics, Performance Limitations, Resolution, Offset and Gain Error, Accuracy and Linearity, Successive approximation architectures, Flash architectures.

UNIT V

Integrator Based Filters Low Pass filters, active RC integrators, MOSFET-C integrators, transconductance-c integrator, discrete time integrators. Filtering topologies - bilinear transfer function and biquadratic transfer unction, phase-locked loop basics; PLL dynamics; frequency synthesis; all-digital PLLs.

References

1.Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.
2.Razavi, “Principles of data conversion system design”, Wiley IEEE Press, 1st Edition, 1994.
3.Jacob Baker, “CMOS Mixed-Signal circuit design”, IEEE Press, 2009.
4.Gregorian, Temes, “Analog MOS Integrated Circuit for signal processing”, John Wiley & Sons, 1986.
5.Baker, Li, Boyce, “CMOS: Circuit Design, layout and Simulation”, PHI, 2000.
6. P.E. Allen, Doug Holberg, “CMOS Analog Circuit Design”, Oxford University Press, 2011.

PEC2ECE714E

MIXED SIGNAL DESIGN LAB

List of Experiments:

Section I: ***Learning the CAD tool.***
Introduction to Cadence, Learning Cadence design framework and Virtuoso environment, Design with Virtuoso schematic editor, Layouts etc.

Section II: ***List of Experiments:***
1. Simulation and analysis of a basic Current mirror circuit.

2. Simulation and analysis of a bipolar current mirror circuit.

3. Design of Common Source Amplifier with different Loads

4. Simulation and design Differential Amplifier

5. Design, Simulation and analysis of an open loop track and hold using MOS technology.

6. Design, Simulation and analysis of Sample and Hold circuit with clock feedthrough circuitry.

7. Design and analysis of a voltage comparator circuit.

8. Design and analysis of ADC (e.g Flash)

9. Design, Simulation and analysis of first order RC filter circuit.

10. Design, Simulation and analysis of low Q and high Q bi-quad filters.

11. Design, Simulation and analysis of first order Gm-C filter circuit.

Tools Required: Cadence Virtuoso/ Advanced Design System/ any other industry grade CAD tool.

PEC2ECE715E

ANTENNA DESIGN

UNIT I

Antenna Fundamentals and Types: Radiation mechanism - over view, Electromagnetic Fundamentals, Solution of Maxwell's Equations for Radiation Problems, Ideal Dipole, Antenna Parameters.

Antenna types: Wires, Patches and Broadband, Dipole Antennas, Yagi - Uda Antennas, Micro strip Antenna, Travelling-wave Wire antennas, Helical antennas. Log - Periodic Antennas, spiral antennas, lens antennas etc

UNIT II

Antenna Arrays: Array factor for linear arrays, uniformly excited, equally spaced Linear arrays, pattern multiplication, directivity of linear arrays, non- uniformly excited -equally spaced linear arrays, Mutual coupling, multidimensional arrays, phased arrays, feeding techniques.

UNIT III

Aperture/Reflector Antennas: Radiation from Aperture and Huygen's principle, uniqueness theorem, Application of the equivalence principle to Aperture problems, uniform Rectangular aperture and radiating slit. Techniques for evaluating Gain .Reflector antennas - Parabolic reflector antenna principles, Axi - symmetric parabolic reflector antenna, offset parabolic reflectors, dual reflector antennas, Gain calculations for reflector antennas, feed antennas for reflectors, field representations, matching the feed to the reflector, general feed model.

UNIT IV

Antenna Synthesis: Formulation of the synthesis problem, synthesis principles, line sources shaped beam synthesis, linear array shaped beam synthesis — Fourier series, Woodward — Laws on sampling method, etc

UNIT V

CEM for Antennas: General Introduction. **Method of Moments**: Introduction to method of Moments, Pocklington's integral equation, integral equations and Kirchoff's Networking Equations, Source Modeling Weighted residuals formulations and computational consideration, calculation of Antenna and scatter characteristics. **Finite Difference Time Domain Method**: Maxwell equations for FTDT method, E - Plane analysis of Horn antennas. **High Frequency Methods:** Geometric optics, Wedge diffraction theory, E - Plane analysis of Horn antennas. Cylindrical parabolic antenna, radiation by a slot and monopole on a finite ground plane, Application of UTD to wireless mobile propagation.

UNIT VI

Basic Concepts of Smart Antennas: Concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beam forming. **Instructional Activities:** Design, simulation and analysis of different antennas for wireless applications using related simulation tools.

References

1. Stutzman and Thiele, "Antenna Theory and Design", 2nd Ed, John Wiley and Sons Inc.
2. C. A. Balanis: "Antenna Theory and Design", John Wiley, 3rd Edition, 2005
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd Edition, Tata McGraw Hill, 2002.
4. Elliot R S, "Antenna Theory and Design", Revised Edition, John Wiley and Sons, India, 2006.
5. F . B. Gross, "Smart Antennas for Wireless Communications", McGraw-Hill., 2005.
6. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.

PEC2ECE716E
ANTENNA DESIGN LAB

List of Experiments

A: Using Antenna Training System

1) Study different types of Antennas
2) Measurement of Radiation pattern of monopole, dipole, folded dipole, helix, Loop (rectangular and circular) antennas.
3) Study the structure, operation and radiation pattern of wired, aperture, planar and array antennas.
4) Proof of Inverse square law and Reciprocity theorem
5) Measurement of radiation pattern of reflector antennas
6) Study of variation in the radiation strength at a given distance from the antenna
7) Study of Yagi-UDA 5 Element Simple dipole antenna

B: Simulation using HFSS/CST:

1) Analysis of co-polarization and cross polarization.
2) Measurement of radiation pattern of planar antennas
3) Antennas Arrays and beamforming
4) Design micro strip patch antennas
5) Design reflector antennas
6) Design Horn antennas

Tools Required: HFSS Antenna design Suite, MATLAB, CST, Antenna Training System

Open Elective Courses

OECECE801E
INTERNET OF THINGS

UNIT I

What is IoT, why IoT matters, the power of IoT, Examples and Applications, How an IoT System Actually works, Structure of IoT.

UNIT II

Sensors and Devices: Hardware Capabilities Scaling & Operations, Industrial sensors, First Generation – Description, Advanced Generation, Integrated IoT Sensors, Polytronics Systems, Sensors' Swarm ,Printed Electronics ,IoT Generation Roadmap ,Wireless Sensor Structure– Energy Storage Module–Power Management Module–RF Module–Sensing Module

UNIT III

Connectivity: An introduction to Connectivity, LPWAN, Cellular, Satellite, WiFi, Bluetooth, Data Processing: Introduction to Cloud, Introduction to IoT platforms, Choosing an IoT Platform, API's, Data Analytics vs Machine Learning

UNIT IV

User Interface & User Experience in IoT, Introduction to UIs & UX for IoT2, Key Considerations for UIs, The Future of IoT and Case Study: Smart Cities, Healthcare, Agriculture

References

1. Dr. Guillaume Girardin, Antoine Bonnabel, Dr. Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024', Yole Development Copyrights ,2014
2. Peter Waher, 'Learning Internet of Things', Packt Publishing, 2015
3. Editors OvidiuVermesan Peter Friess,'Internet of Things – From Research and Innovation to Market
4. N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014

OECECE802E
INTERNET OF THINGS LAB

List of Experiments:

1. Arduino Uno Architecture, Arduino Simulation Environment, Setup the IDE, Introduction Arduino Libraries.

2. Basics of Embedded C programming for Arduino.

3. Interfacing LED, push button and buzzer with Arduino.

4. Interfacing Arduino with LCD.

5. Interfacing of Temperature, Humidity, Motion, Light and Gas Sensor with Arduino.

6. Interfacing of Relay Switch and Servo Motor with Arduino.

7. Introduction to ESP8266 Wi-Fi Module, Various Wi-Fi library.

8. Web server- introduction, installation, configuration.

9. Posting sensor(s) data to web server.

10. Study of IOT Cloud platforms Thing Speak API and MQTT.

11. Interfacing ESP8266 with Web services.

12. Introduction to Contiki-Cooja Platform.

Tools Required:

1. **Hardware:** Arduino, Raspberry Pi, Intel Galileo, BeagleBone, Smart Phones.
2. **Software:** Contiki on Ubuntu machine.

OECECE803E
SENSORS AND ACTUATORS FOR IOT

UNIT I

Sensors / Transducers: Principles – Classification – Parameters – Characteristics - Environmental Parameters (EP) – Characterization Mechanical and Electromechanical Sensors: Introduction – Resistive Potentiometer – Strain Gauge – Resistance Strain Gauge – Semiconductor Strain Gauges -Inductive Sensors: Sensitivity and Linearity of the Sensor –Types-Capacitive Sensors:– Electrostatic Transducer– Force/Stress Sensors Using Quartz Resonators – Ultrasonic Sensors

UNIT II

Thermal Sensors: Introduction – Gas thermometric Sensors – Thermal Expansion Type Thermometric Sensors – Acoustic Temperature Sensor – Dielectric Constant and Refractive Index thermos sensors – Resistance Change Type Thermometric Sensors –Thermo emf Sensors– Junction Semiconductor Types– Thermal Radiation Sensors –Quartz Crystal Thermoelectric Sensors – NQR Introduction – Sensors and the Principles Behind – Magneto-resistive Sensors – Anisotropic Magneto resistive Sensing – Semiconductor Magneto resistors– Hall Effect and Sensors – Inductance and Eddy Current Sensors– Angular/Rotary Movement Transducers – Synchros– Synchro-resolvers - Eddy Current Sensors – Electromagnetic Flowmeter – Switching Magnetic Sensors SQUID Sensors

UNIT III

Radiation Sensors: Introduction – Basic Characteristics – Types of Photosensistors/Photo detectors– X-ray and Nuclear Radiation Sensors– Fiber Optic Sensors Electro analytical Sensors: Introduction – The Electrochemical Cell – The Cell Potential - Standard Hydrogen Electrode (SHE) – Liquid Junction and Other Potentials – Polarization – Concentration Polarization–– Reference Electrodes - Sensor Electrodes – Electro ceramics in Gas Media.

UNIT IV

Smart Sensors: Introduction – Primary Sensors – Excitation – Amplification – Filters – Converters – Compensation– Information Coding/Processing - Data Communication – Standards for Smart Sensor Interface – The Automation Sensors –Applications: Introduction – On-board Automobile Sensors (Automotive Sensors)– Home Appliance Sensors – Aerospace Sensors –– Sensors for Manufacturing – Sensors for environmental Monitoring

UNIT V

Actuators: Pneumatic and Hydraulic Actuation Systems- Actuation systems – Pneumatic and hydraulic systems - Directional Control valves – Pressure control valves – Cylinders - Servo and proportional control valves – Process control valves – Rotary actuators Mechanical Actuation Systems- Types of motion – Kinematic chains – Cams – Gears – Ratchet and pawl – Belt and chain drives – Bearings – Mechanical aspects of motor selection Electrical Actuation Systems-Electrical systems -Mechanical switches – Solid-state switches Solenoids – D.C. Motors – A.C. motors – Stepper motors

Recommended Books:

1. D. Patranabis – “Sensors and Transducers” –PHI Learning Private Limited.

2. W. Bolton – “Mechatronics” –Pearson Education Limited.

Reference Books:

1. Sensors and Actuators – D. Patranabis – 2nd Ed., PHI, 2013.

OECECE804E
SENSORS AND ACTUATORS FOR IOT LAB

List of Experiments:

1. Calibration of various electromechanical sensors and Interfacing with PC or Microcontrollers.
2. Calibration of various Thermal sensors and Interfacing with PC or Microcontrollers.
3. Calibration of various Optical sensors and Interfacing with PC or Microcontrollers.
4. Calibration of various automation sensors and Interfacing with PC or Microcontrollers.
5. Study of various off the shelf sensor modules and interfacing with PC or Microcontrollers.
6. Design and implementation of Signal conditioning circuits for basic transduction elements.
7. Interfacing of various actuators with PC or microcontrollers.
8. Design of a full automation system with sensors, actuators and processing elements.

Tools Required: MATLAB, LABVIEW, Proteus, Arduino.

OECECE805E
DEEP LEARNING

UNIT I

Introduction: Course logistics and overview. Linear Algebra Review: Brief review of concepts from Linear Algebra. Optimization: Types of errors, bias-variance trade-off, overfitting-underfitting, brief review of concepts from Vector Calculus and optimization, variants of gradient descent, momentum.

UNIT II

Logistic Regression: Basic concepts of regression and classification problems, linear models addressing regression and classification, maximum likelihood, logistic regression classifiers.

UNIT III

Neural Networks: Basic concepts of artificial neurons, single and multi-layer perceptrons, perceptron learning algorithm, its convergence proof, different activation functions, softmax cross entropy loss function.

UNIT IV

ConvNets: Basic concepts of Convolutional Neural Networks starting from filtering. Convolution and pooling operation and arithmetics. Regularization, Dropout, Batchnorm, etc. Convnet architectures - AlexNet, VGG, GoogLeNet, ResNet, MobileNet-v1, InceptionNet, etc.

UNIT V

Deep Learning Tasks: Detection, segmentation problem definition, challenges, evaluation. Classification, region proposals, RCNN and other architectures and techniques. Applications of deep learning to computer vision, speech recognition, etc.

References

1. "Deep Learning", I Goodfellow, Y Bengio and A Courville, 1st Edition, MIT Press
2. Python Machine Learning for Beginners: Handbook for Machine Learning, Deep Learning and Neural Networks Using Python, Scikit-Learn and TensorFlow by Sanders, Finn
3. Deep Learning with Python, François Chollet

OECECE806E
DEEP LEARNING LAB

List of Experiments:

1. Introduction to Python based Deep Learning-I
2. Introduction to Python based Deep Learning-II
3. Introduction to online Python Coding Platforms: Google COLAB, KAGGLE, etc.
4. Designing, training and evaluating a basic shallow neural net in Python.
5. Designing, training and evaluating a deep neural net in Python.
6. Using Transfer Learning for fine-tuning of a pre-trained CNN
7. Experiment on Computer Vision using Deep Learning.
8. Experiment on Speech Recognition using Deep Learning.
9. Using Tensor Processing Units (TPUs) for Deep Learning.

Tools required:

1. Python Software
2. MATLAB Software
3. Online Computing Platforms: Google Colab, Kaggle.

OECECE807E
INDUSTRIAL IOT

UNIT I

Introduction to Industrial Internet of Things• Embedded systems & computer networks• Machine-to-machine (M2M) communication• Internet of Everything (IoE)• Machine learning & artificial intelligence• Distributed computing• Industrial automation• Interoperability, identification localization, communication, and software-defined assets• Evolution of IIoT – understanding the IT & OT convergence• OT components like Industrial control systems, PLC, SCADA, and DCS• IT components like hardware, software, and people processes• Adoption of IIoT• Market trends and opportunities in IIoT

UNIT II

Industrial automation – PLC & SCADA• History of automation – plants to parts• Knowledge discovery process• The DIKW (Data, Information, Knowledge, and Wisdom) pyramid and its relevance in IoT• PLC vs. Microcontrollers• Industrial networks• Machine-to-machine networks

UNIT III

Sensor data mining and analytics• Transducers: Sensors & actuators• Data acquisition, storage, and analytics• Real-time analytics• Understanding the differences between IoT and Big Data• Improving operational efficiency with IoT• Edge analytics & data aggregation

UNIT IV

Wireless Sensor Area Networks (WSAN)• Sensor nodes• WSN communication technology• Fundamentals and applications of Bluetooth, Zigbee, and WiFi• Fundamentals and applications of Cellular communication and LPWAN technology

UNIT V

Design & development of IIoT systems• IIoT reference architectures• Standardization initiatives• Interoperability issues• Industrial internet reference architecture from Industrial Internet Consortium (IIC)• IIoT design considerations• Centralized vs. distributed architectures• Industrial networks, communication technologies, protocols

UNIT VI

Industry 4.0 – Smart Factories• Integration of products, processes, and people• Smart factories and cyber-physical systems• Design principles• Challenges on the path to be a smart factory

UNIT VII

Industrial cloud platforms• Industrial gateways• Commercial gateways by Intel and Cisco• Cloud-based gateway solutions• IaaS, PaaS, and SaaS models• Cloud components and services• Device management, databases, visualization, and reporting• Notification management• Security management• Cloud resource monitoring and management• AWS IoT• Microsoft Azure IoT• GE Predix• PTC Thingworx

References

1. Hands-On Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0 Paperback – 1 January 2018 by Giacomo Veneri Antonio Capasso
2. Introduction to Industrial Internet of Things and Industry 4.0 1st Edition CRC Press by Sudip Misra
3. IoT Fundamentals | Networking Technologies, Protocols, and Use Cases for the Internet of Things | First Edition Pearson Paperback – 16 August 2017 by Hanes David, Salgueiro Gonzalo, Grossetete Patrick
4. IoT - Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT Paperback – February 21, 2020 by Charles Crowell
5. Getting started with the Internet of Things O'RELLY publications by Cuno Pfister

OECECE808E
INDUSTRIAL IOT LAB

List of Experiments:

1: Study hardware and software used in PLC

2: Implementation of Logic Gates

3: Develop a ladder program for DOL Starter

4: Develop an application using On-Delay Timer

5: Develop an application using Up-Down Counter

6: Implementation of PLC Arithmetic Instructions for a pilot plant

7: Study of PID controller instruction for a pilot plant

8: Study hardware and software platforms for DCS

9: Simulate analog and digital function blocks

10: Study, understand and perform experiments on timers and counters

11: Logic implementation for traffic Control Application

12: Logic implementation for Bottle Filling Application

Tools Required: PLC kits, DCS kits, SCADA software.

OECECE809E
ROBOTICS ENGINEERING

UNIT I

Introduction, History of robots, Classification of robots, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT II

Drive systems and Sensors Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT III

Kinematics and Dynamics of Robots 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

UNIT IV

Robot Control, Programming and Applications Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples. Robot applications-Material handling, Machine loading and unloading, assembly, Inspection, Welding.

Recommended Books:

[T1] Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.

[T2] Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999.

Reference Books:

[R1] S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009.
[R2] Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
[R3] Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
[R4] P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
[R5] Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
[R6] Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
[R7] Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

OECECE810E

ROBOTICS ENGINEERING LAB

List of Experiments:

1. Basic experiments on introduction to Robot Configuration.
2. Demonstration of Robot with 2 DOF, 3 DOF, 4 DOF, etc.
3. Experiments on programming a robot for applications.
4. Two case studies of Robotics Applications in Industry.
5. Experiments on Robotic Simulation Software.

OECECE811E

MECHATRONICS

UNIT I
Introduction, Examples of Mechatronic systems, Electric circuits and components, Semiconductor Electronics, Transistor Applications

UNIT II
Sensors and transducers: Performance terminology of sensors, Displacement, Position & Proximity Sensors-I, Displacement, Position & Proximity Sensors-II, Force, Fluid pressure, Liquid flow sensors, temperature, light sensor, Acceleration and Vibration measurement, Semiconductor sensor and MEM, SAW

UNIT III
Actuators and mechanisms: Mechanical Actuation System, Hydraulic & Pneumatic Actuation System, Electrical Actuation System-I, Electrical Actuation System-II, Data Presentation system

UNIT IV
Signal conditioning: Introduction to signal processing & Op-Amp, Op-Amp as signal conditioner, Analogue to Digital Converter, Digital to Analogue Converter, Artificial intelligence

UNIT V
Microprocessors and microcontrollers: Digital circuits-I, Digital circuits-II, Microprocessor Micro Controller, Programming of Microcontrollers

UNIT VI
Modeling and system response: Mechanical system model, Electrical system model, Fluid system model, Dynamic response of systems, Transfer function and frequency response.

UNIT VII
Closed loop controllers: P, I, PID Controllers, Digital Controllers, Program Logic Controllers, Input/output & Communication systems, Fault findings

References

1. William Bolton, “Mechatronics electronic control systems in mechanical and electrical engineering”, 6th Edition, Pearson Education, 2002.
2. David G. Alciatore, Micheal B. Histand “Introduction to MECHATRONICS and measurement systems”, 4th edition, Mc Graw Hill Education-2014
3. M.D. Singh, J.G. Joshi, “Mechatronics”, PHI Publications

OECECE812E
MECHATRONICS LAB

List of Experiments:

1. Interfacing of various sensor and actuator modules with microcontrollers.

2. Use of A/D and D/A converters for signal conditioning of sensor signals.

3. Design and Implementation of OP-AMP based signal conditioning circuits for optical and thermal sensors.

4. Mechanical system modeling on PC.

5. Electrical system modeling on PC.

6. Working with PID controllers.

7. Project using Microcontroller-Atmega 328, Myoelectrically Controlled Robotic Arm, Design of a Legged Robot

Tools Required: MATLAB, MATLAB supported EMBEDDED hardware, LABVIEW.

OECECE813E
MICROPROCESSORS IN AUTOMATION

UNIT I

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip-flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals.

UNIT II

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing

UNIT III

Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt Requests and their handling, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).

UNIT IV

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features,

UNIT V

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm.

References

1. Digital Electronics: An Introduction to Theory and Practice by William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers by Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd
3. Microprocessor Architecture, Programming, and Applications with the 8085 by Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems by Benjamin C. Kuo, Oxford University Press
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal Prentice Hall

OECECE814E
MICROPROCESSORS IN AUTOMATION LAB

1. Design and implementation of:
    a. basic Gates: AND, OR, NOT.
    b. Universal gates.
    c. Basic Flip-Flops
2. Using 8085 microprocessor:
    i. develop a program to add two double byte numbers.
    ii. develop a subroutine to add two floating point quantities.
    iii. develop program to multiply two single byte unsigned numbers, giving a 16-bit product
    iv. develop subroutine which will multiply two positive floating-point numbers.
    v. To write program to evaluate P* Q*+R* & S where P, Q, R, S are 8-bit binary numbers.
    vi. To write a program to divide an 8-bit number by another 8-bit number up-to a
    vii. fractional quotient of 16 bit.
    viii. Write a program for adding first N natural numbers and store the results in memory location X.
    ix. Write a program which decrements a hex number stored in register C. The Program should half when the program register reads zero.
    x. Write a program to introduce a time delay of 100 ms using this program as a subroutine display numbers from 01H to OAH with the above calculated time delay between every two numbers.
    xi. N hex numbers are stored at consecutive memory locations starting from X. Find the largest number and store it at location Y.
3. Interface a display circuit with the microprocessor either directly with the bus or by using I/O ports. Write a program by which the data stored in a RAM table is displayed.
4. To design and interface a circuit to read data from an A/D converter, using the 8255 A in the memory mapped I/O.
5. To design and interface a circuit to convert digital data into analog signal using the 8255A in the memory mapped I/O.
6. To interface a keyboard with the microprocessor using 8279 chip and transfer the output to the printer.
7. To design a circuit to interface a memory chip with microprocessor with given memory map.
8. Write a program to control the operation of stepper motor using 8085 and 8255 PPI.