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.