Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(*An Autonomous Institute affiliated to Savitribai Phule Pune University*)

Structure & Syllabus of

S. Y. B. Tech.

(Electronics &Telecommunication Engineering)

Pattern 'B-19'

Academic Year 2019-20

Prepared by: - Board of Studies in E&TC Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

Institute Vision:
To be a globally acclaimed Institute in Technical Education and Research for holistic Socio-economical development

Institute Mission:
- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision:
To be a center of Academic Excellence in Electronics, Telecommunication and Related Domains through Continuous Learning and Innovation.

Department Mission:
- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in social context.

Program Educational Objectives (PEOs):
Graduates of the program will
- Have comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real life complex problems
- Be professionals imbibed with a spirit of leadership, ethical behavior and societal commitment
- Be compliant to constantly evolving technology through lifelong learning

Program Outcomes:
Engineering Graduates will be able to:
1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and

environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Objectives (PSOs)

E&TC Graduates will have Ability to:

1. Design, Develop and Analyze Complex Electronic Systems for Communication, Signal Processing, Embedded Systems and VLSI Applications.
2. Identify and Apply domain specific hardware and software tools to solve real-world problems in Electronics and Communication.

Title: Course Structure **FF No. : 653**

Branch: E&TC Year: S. Y. Academic Year: 2019-20 Semester: I Module: NA Pattern: B-19

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
S1	ET2101	Electronic Circuits	3	2	10	30	15	10	15	20	100	4
S2	ET2003	Network Theory	3	2	10	30	15	10	15	20	100	4
S3	ET2005	Signals & Systems	3	2	10	30	15	10	15	20	100	4
S4	ET2002	Data Structures and Algorithms	3	2	10	30	15	10	15	20	100	4
S5	ET2111	Probability & Random Variables	2	-	20	-	30	-	30	20	100	2
S6	ET2016	Engineering Design & Innovation 1	2	4	-	-	50		50	-	100	4
Total												22

Abbreviations Used	
ISA	In Semester Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment
GD/PPT	Group Discussion /Power Point Presentation

Title: Course Structure **FF No. : 653**

Branch: E&TC **Year: S. Y.** **Academic Year: 2019-20** **Semester: II** **Module: NA** **Pattern: B-19**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
S1	ET2007	Control Systems	3	2	10	30	15	10	15	20	100	4
S2	ET2004	Communication Engineering	3	2	10	30	15	10	15	20	100	4
S3	ET2006	Electromagnetic Engineering	3	2	10	30	15	10	15	20	100	4
S4	ET2015	Digital Systems	3	2	10	30	15	10	15	20	100	4
S5	ET2012	Multivariate Data Analysis	2	-	20	-	30	-	30	20	100	2
S6	ET2017	Engineering Design & Innovation 2	2	4	-	-	50		50	-	100	4
	ET2014	**General Proficiency 2										0
Total												22

Abbreviations Used	
CA	Continuous Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment

(**) Audit Course evaluated in second semester

FF No. : 654

ET2101: Electronic Circuits

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section I

Drift, diffusion, Conductivity, Mobility, Mass action law, ,Potential across Graded semiconductor, Open circuited step graded junction, PN junction diode, Forward and reverse biased diode operation, V-I characteristic equation of diode, Temperature dependence of V-I characteristics, Forward and reverse dynamic resistance, Small signal diode models, junction capacitance, analysis of diode circuits like clippers clampers, rectifiers, voltage regulators.

BJT as a device, Construction, typical junction voltages for cutoff, active and saturation regions, concept of amplification, BJT configurations(CE, CB, CC), Input and output characteristics, applications of CE, CB, CC and comparison, their suitability in cascaded stages, small signal-low frequency h-parameter model, Variation of h-parameters with operating point

DC analysis of BJT circuits, Concept of load line, BJT biasing: Fixed bias, voltage divider bias, collector to base bias Determination of Q point

Section II

AC Analysis of CE, CC, CB configuration for performance parameters in terms of h parameters, Comparison of performance parameters in CE, CC and CB configurations

Introduction to JFET, I-V Characteristics, MOS capacitor,), Cut-off & Pinch-off voltages, Transconductance, Input resistance & Capacitance, MOS capacitor, concept of accumulation, depletion and inversion, Types of MOSFET, I-V characteristics, drain current equation, Channel length modulation, Non ideal characteristics

JFET/ MOSFET biasing, DC analysis of FET circuits, FET small signal AC equivalent model, AC Analysis of CS, CD , CG amplifiers for performance parameters

List of Practicals:

1. Clipper circuits
2. Clamper circuits
3. Diode rectifiers
4. JFET characteristics
5. JFET biasing
6. MOSFET as a switch
7. BJT Characteristics
8. BJT as a switch
9. BJT CE Amplifier
10. BJT CC amplifier

List ofProject areas:

1. BJT as a switch
2. Cascaded amplifier
3. Unregulated power supply
4. Regulated power supply
5. MOSFET applications

Text Books

1. Integrated Electronics, MillmanHalkias, Tata McGraw Hill
2. Electronic Devices, Thomas L. Floyd, Pearson Education

Reference Books

1. Solid State Electronic Devices, B.G. Streetman, PHI, New Delhi.
2. Electronic Devices & Circuit Theory, R. L. Boylestad, L. Nashelsky, PHI, New Delhi.

CourseOutcomes:

Students will be able to

1. Elaborate operation and characteristics of semiconductor diodes
2. Analyze diode circuits
3. Compare BJT configurations
4. Elaborate operation and characteristics of FET
5. Analyze BJT/ FET circuits to find Q point
6. Analyze BJT/ FET amplifiers to find amplifier parameters

FF No. : 654

ET2003: Network Theory

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1

Network Theorems: Superposition, Thevenin's Norton's and Maximum Power transfer Theorems. (DC and AC)

Concept of Network Topology, Terms used in Topology, Relation between Twigs and Links Properties of a Tree in a Graph, Formation of Incidence Matrix [Ai], number of tree in Graph. Cut –Set Matrix, Network Equilibrium Equation.

Terminal characteristics of network: Z, Y, h, ABCD Parameters; Reciprocity & Symmetry conditions, Interrelation of Parameters, interconnection of parameters. Network functions for one port and two port networks. Pole-zeros of network functions and network stability

Section 2:

Classifications: Symmetrical and Asymmetrical networks. Properties of two port Network: Symmetrical Networks (T and Π only). Z0 and γ in terms of circuit components, open and short circuit parameters, Filter fundamentals, Constant K -LPF, HPF, BPF and BSF, m derived LPF and HPF, introduction to Neper and Decibel, Relation between Neper and Decibel, Symmetrical T and Π type attenuators, Lattice attenuator, Bridge T-attenuator. Asymmetrical Networks: Image Impedance and Iterative Impedance (L-Section only).Terminating half sections, Asymmetrical L- type.

Transient response of passive circuits, transient response of series RL, RC and RLC circuits with DC and sinusoidal excitation

Significance of Quality factor, Series Resonance: Impedance, Phase angle variations with frequency, Voltage and current variation with frequency, Bandwidth, Selectivity Resonant frequency and admittance variation with frequency, Bandwidth and selectivity. Magnification factor, Parallel resonance: General case: Resistance present in both branches

List of Practicals (Any Six):

1. To study and verify the Thevenin's Theorem and Norton's Theorem,
2. To study the Superposition Theorem and Maximum Power Transfer Theorem
3. To Measure and Verify of Z, Y, Parameters of a Two-port Network
4. To determine equivalent parameters of parallel connection of two-port network.
5. To find critical frequencies (poles and zeros) of LC impedance driving point function.

6. To study the operation of low pass and high pass prototype filters.
7. To study the operation of band pass and band stop prototype filters
8. To study of T –type and π- type attenuator.
9. To study the transient response of a RL and RC circuit
10. To study the frequency response of a RLC series circuit

List of Projects (Any One):

1. Design Passive Prototype Low pass filter having cut-off frequency 2 KHz with design impedance 600 Ω in T and π section. Select frequency range up to 1 MHz with input voltage 5V
2. Design Passive Prototype High pass filter having cut-off frequency 10 KHz with design impedance 600 Ω in T and π section. Select frequency range up to 1 MHz with input voltage 5V
3. Design Passive Prototype Band pass filter having cut-off frequencies 3000 Hz and 6000Hz with design impedance 600 Ω in T and π section. Select frequency range up to 1 MHz with input voltage 5V
4. Design Passive Prototype Band pass filter having cut-off frequencies 2000 Hz and 5000Hz with design impedance 600 Ω in T and π section. Select frequency range up to 1 MHz with input voltage 5V
5. Design a π-type attenuator to give attenuation of 20 dB and characteristic resistance of 500 Ω.
6. Design a T-type attenuator to give attenuation of 20 dB and characteristic resistance of 500 Ω

Text Books:

1. "Circuit Theory (Analysis and Synthesis)",Chakrabarti, Dhanpat Rai and Co.
2. "Electrical Networks", Ravish R Singh, Tata Mc-Graw Hill

Reference Books:

1. "Network Analysis", Van Valkenberg, PHI
2. "Kuo F. F., "Network Analysis and Synthesis", 2nd Ed., Wiley India.
3. "Engineering Circuit Analysis, Hayt W. H., Kemmerly J. E. and Durbin S. M., 6th Ed., Tata McGraw-Hill Publishing Company Ltd

Course Outcomes:

The students will be able to

1. Simplify networks and circuits using network theorems and graph theory. (CO Attainment level : 4)

2. Simplify networks and circuits using graph theory and Network Topology. (CO Attainment level : 3)
3. Find network parameters and network function. (CO Attainment level : 4)
4. Design Attenuators and filters. (CO Attainment level : 4)
5. Analyze RL, RC and RLC Circuits using steady state and transient response. (CO Attainment level : 4)
6. Analyze Resonance Circuits. (CO Attainment level : 3)

FF No. : 654

ET2005: Signals and Systems

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to signals and systems, signal classification, elementary signals, signal operations on dependent and independent variables, sampling theorem. Classification of systems, time domain analysis of LTI systems: convolution integral, convolution sum, correlation.Continuous time Fourier series: Trigonometric, exponential form of Fourier series, Frequency spectrum of CT periodic signals, Gibbs phenomenon.

Section2:

Continuous time Fourier transform, existence of Fourier transform, properties, system analysis using Fourier transform. Introduction to energy spectral density (ESD) and power spectral density (PSD). Discrete time Fourier transform, discrete frequency spectrum, analysis of discrete-time LTI systems using DFT. Laplace transform, region of convergence, properties, Pole-zero plots, inverse Laplace transform, circuit analysis using Laplace transform.

List of Practicals (Any Six):

1. To generate different continuous time and discrete time signals like sinusoidal signal, ramp signal, step signals, exponential signal etc.
2. To perform different operations on the signals.
3. To find the response of a given discrete time system to any arbitrary discrete time input signal
4. To perform Fourier analysis of the given signal to find the spectral components.
5. To find autocorrelation and cross correlation of given sequences.
6. Generate a discrete time sequence by sampling the given continuous time signal by varying the sampling frequency and to observe the aliasing.
7. To obtain the step response and impulse response of the given system.
8. To analyze the given discrete time signal in frequency domain using DFT.
9. To obtain ESD and/or PSD of a given signal.
10. To perform the pole-zero analysis of the given system using Laplace Transform

List of Projects (Any One):

1. To separate voiced/unvoiced/silence part of the speech signal.

2. Design a MATLAB app to generate different continuous and discrete time signals and to plot their spectra.
3. Design a MATLAB app for Fourier series synthesis of different signals.
4. ECG signal Analysis
5. Isolated word recognition using correlation
6. Generation of different audio effects like echo, reverberation flanger etc.
7. Analysis of given CT-LTI system using Laplace transform
8. Analysis of different musical instruments (air instruments like harmonium, flute)
9. Analysis of different musical instruments (string instruments like guitar, sitar)

Text Books:

1. Alan V. Oppenheim, Alan S. Wiisky and S. Hamid Nawab, "Signals and systems," Pearson Education, 2004.
2. Ramesh Babu and Anandnatarajan, "Signals and Systems," Scitech Publication, Fourth Edition.

Reference Books:

1. Haykin Simon and Veen Barry Van, "Signals and Systems," New York. John Wiley & Sons.
2. Roberts Michael J, "Signals and Systems," Tata McGraw Hill Publishing Company Limited, 2003.
3. A. NagoorKani, "Signals and Systems," McGraw Hill, 2013.

Course Outcomes:

The student will be able to –

1. Perform operations on dependent and independent variable of one dimensional signals (CO Attainment level : 3)
2. Synthesize the signal using elementary signals (CO Attainment level : 4)
3. Classify the systems and determine response of given CT/DT LTI system to any arbitrary input using convolution integral/sum (CO Attainment level : 4)
4. Analyze the given CT deterministic signal in spectral domain using Fourier series/transform. (CO Attainment level : 5)
5. Apply sampling theorem to obtain a discrete time signal from a continuous signal and to find the spectral components of the discrete-time signal using discrete Fourier transform (DFT). (CO Attainment level : 4)
6. Analyze the given LTI systems using Laplace transform. (CO Attainment level : 3)

FF No. : 654

ET2002: Data Structures & Algorithms

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Analysis of algorithms. Asymptotic analysis, asymptotic notations, Searching and sorting algorithms. Linear Data Structures: Stack, Queue, Linked list, Expression conversion and evaluation, Generalized liked list

Section 2:

Tree, Binary search tree, Tree traversal, threaded binary tree, implementation of tree using linked list, Expression tree, application of trees, Graphs, representation of graphs, Graph traversal, minimum spanning tree and algorithms, shortest path algorithms.

List of Practicals (Any Six):

1. Implement sorting algorithms
2. Implement searching algorithms
3. Create and manipulate Database using Array
4. Create and manipulate Database using Linked List
5. Addition of two single variable polynomials using Linked List.
6. Implementation of Stacks
7. Conversion of infix expression to postfix expression and evaluation of postfix expression
8. Implementation of Queue
9. Operations on Binary Search Tree.
10. Create a graph using adjacency list

List of Projects (Any One):

Project based on

1. Dijkstra's algorithm
2. Prim's algorithm
3. Kruskal algorithm
4. Binary Trees
5. Expression trees
6. Binary heap
7. Stack and it application

8. Queue and its application
9. Linked list based project.
10. Hash tables.

Text Books:

1. Tenenbaum A M &Langsam Y: Data Structure Using C. Prentice Hall Of India, New Delhi.
2. Horowits E &Sahni S: Fundamentals of Data Structures. Gurgaon. Galgotia Book Source New Delhi.

Reference Books:

1. Kruse R L, Leung B P &Tondo C L: Data Structure And Programming Design In C. Prentice Hall Of India Pvt.ltd.
2. Data Structures : Schaum Outline Series, TMH

Course Outcomes:

The student will be able to –

1. Find time complexity using Big-O notation. (CO Attainment level : 4)
2. Explain the concept of sequential organization, ordered list and dynamic memory management. (CO Attainment level :3)
3. Solve Engineering problems by employing Stack, Queue and Linked list data structure. (CO Attainment level : 4)
4. Explain and analyze major Tree algorithms. (CO Attainment level : 4)
5. Explain and analyze major Graph algorithms. (CO Attainment level : 4)
6. Solve Engineering problems by employing trees and graph data structure. (CO Attainment level : 4)

FF No. : 654

ET2111: Probability and Radom Variables

Credits: 2 **Teaching Scheme: 2 Hours / Week**

Section 1:

Data basics – numerical and categorical variables, Observational studies and experiments, sampling and sources of bias - exploratory analysis and inference, sampling methods – simple, stratified, cluster and multistage sampling, experimental design – principles of experimental design, Experimental terminology – placebo, blinding etc., Measures of center and spread, data transformation

Probability basics; Independence; Conditional probability; Probability trees; Bayesian inference; Probability distributions such as Normal distribution, Binomial distribution etc.

Section 2:

Sampling variability and central limit theorem, Confidence interval for mean, hypothesis testing for mean, Inference, Inference for comparing means, ANOVA, Bootstrapping, Proportions, Hypothesis testing for proportions, Chi-square GOF test, Chi-square independence test

Cumulative distribution function, probability density function, Random Processes such as Laplace, Erlang, Gamma, Chi-square etc.; conditional distributions and density functions; Expected value, moments, central moments; Joint Cumulative distribution function, joint probability density function, Probability mass function

Text Books:

1. Probability and Statistics for Engineers – Johnson, Gupta, Pearson Prentice Hall, 3rd edition
2. Applied statistics and probability for Engineers – Montgomery, Runger, Wiley India, 3rd Edition

Reference Books:

1. Probability and random processes – Miller, Childers, Elsevier, 2nd Edition.

Course Outcomes:

The Student will be able to-

1. Distinguish between various types of variables (CO Attainment level : 1)
2. Apply concepts of probability such as independence, conditional probability (CO Attainment level : 4)

3. Apply Normal distribution and Binomial distribution concepts in case studies (CO Attainment level : 5)
4. 4.Apply variance analysis tests for data analysis (CO Attainment level : 4)
5. Apply Central limit theorem and carry out hypothesis testing (CO Attainment level : 5)
6. Use and apply concepts of various Random Processes in modeling data (CO Attainment level : 4)

FF No. : 654

ET2007: Control Systems

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Introduction, Terminology, Mathematical modeling of electrical, mechanical and electro mechanical systems, Transfer function, State space modeling of dynamical system. Block Diagram, Signal flow graph. Time domain analysis, response to step, ramp and parabolic input, steady state error, transient and steady state analysis. Introduction to PI, PD and PID Controller. Stability, Stability criterion, Root Locus Analysis, Construction of root loci.

Section2:
Frequency Domain Analysis:- correlation between time and frequency responses, Frequency domain specifications. Bode plots, Gain and Phase margin, Polar plot, Nyquist criterion and plot. Design of Compensators

List of Practicals (Any Six):

1. Using Matlab
    a. find the transfer function from Poles and Zeros
    b. find zero's and pole's from transfer function.
2. Using Matlab
    a. Step response of transfer function.
    b. Impulse response of transfer function.
    c. Ramp response of transfer function.
3. Using Matlab find the time response of second order system.
4. Using Matlab
    a. Transfer function from state model.
    b. State model from transfer function.
    c. Step and impulse response of a state model.
5. To perform stability analysis of the system and plot root locus from the transfer function.
6. To plot Bode plot from transfer function.
7. To plot Nyquist plot from transfer function.
8. To find the transfer function of DC motor.
9. To study and simulate PID Controller.
10. To study using Matlab

a. Lag Compensator
b. Lead Compensator
c. Lead lag compensator

11. System identification of DC motor using Matlab.
12. Simulation of any closed loop system.

List of Projects (Any One):

1. Model a given electrical / Mechanical system.
2. Closed loop control of D C Motor.
3. Design and implementation of filter.
4. Compensator design for a low pass filter ad realize using op amp.
5. Eyeball Controlled Automatic Wheelchair.
6. Health Condition Monitoring System.
7. Hardware realization and implementation of closed loop system using Matlab and microcontroller.
8. Implementation of Accelerometer Based Wireless Gesture Controlled Rover.

Text Books:

1. Ogata Katsuhiko, "Modern Control Engineering", 5th Edition, PHI
2. Nagrath I. J. and M. Gopal, "Control Systems Engineering", 6th edition, New Age International

Reference Books:

1. 1 Norman S. Nise, "Control System Engineering", 6th Edition, Wiley.
2. F. Golnaraghi, B.C. Kuo, "Automatic Control Systems", 10th Edition, McGraw-Hill.

Course Outcomes:

The student will be able to –

1. Model a given system using transfer function approach (CO Attainment level : 4)
2. Find steady state and transient response of control systems and understand the behavior of LTI systems qualitatively and quantitatively, both in the transient and steady-state region. (CO Attainment level : 4)
3. Analyze given system for stability using root locus. (CO Attainment level : 4)
4. Demonstrate various techniques of frequency domain analysis. (CO Attainment level : 3)
5. Analyze given system for stability in frequency domain. (CO Attainment level : 4)
6. Design proportional, proportional-integral, proportional-derivative, and proportional-integral-derivative feedback control systems meeting specific system performance requirements. (CO Attainment level : 4)

FF No. : 654

ET2004: Communication Engineering

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

1.1 Introduction To Communication System : Analog & Digital Communication System Overview, The Electromagnetic & Optical Spectrum and its usage, Types of Electronic Communication, Need of modulation, Communication Channels, Classification of noise, Noise in Cascaded Stages.

1.2 Analog Modulation Techniques: Mathematical treatment for an AM and FM signal, Spectral Analysis, Modulation Index, Efficiency, Power calculations, DSB-SC and SSB-SC ,FM generators, pre-emphasis and de-emphasis in FM signal.

1.3 Analog Receivers: TRF Receiver, Super Heterodyne Receiver, Intermediate Frequency and Image Frequency, Diode detector, DSB-SC and SSB-SC, FM Detector

Section 2:

2.1 Sampling and Waveform Coding: Sampling, ideal sampling, Flat top & Natural Sampling, Aliasing, Pulse amplitude modulation, Quantization, Pulse code modulation & reconstruction, Delta modulation, Line Coding, Companded PCM, ISI and eye diagram, Time division multiplexing.

2.2 Digital Modulation Techniques: Digital modulation techniques - Binary Phase Shift Keying, Quadrature Phase Shift Keying, Binary Frequency Shift Keying, Quadrature amplitude modulation, Minimum shift keying.

2.3 Detection and Performance analysis of digital signal: Base Band signal receiver ,Derivation for Error prob of integrate& dump Filter, Optimum Filter, white noise matched filter, probability error of match filter, correlation.

List of Practicals (Any Six):

1. Observe spectral components of time-domain signal using Digital Storage Oscilloscope (DSO).
2. Experiment with Double side band suppressed carrier (DSBSC) modulator and demodulator.
3. Experiment with Single side band suppressed carrier (SSBSC) modulator an demodulator.
4. Experiment with Frequency modulator (FM).

5. Simulation of Analog communication system.
6. Experiment with Pulse Amplitude modulation.
7. Experiment with Pulse Code modulation and demodulation.
8. Experiment with Delta modulation and demodulation.
9. Experiment with Quadrature phase shift keying modulation and demodulation.
10. Experiment with frequency shift keying modulation and demodulation

List of Projects (Any One):

1. Simulation of Analog Communication System
2. Double Side Band –Suppressed Carrier
3. Implementation of Pre-emphasis and De-emphasis for FM
4. Implementation of Antialiasing filter
5. Implementation of Adaptive Delta modulator to avoid slope overload distortion
6. Generation of discrete PAM signal

Text Books:

1. "Principles of Electronic Communication Systems", Louis E Frenzel, Tata McGraw Hill Publications, Third Edition.
2. "Electronic Communication", Kennedy &Devis, Tata McGraw Hill Publications.
3. "Principles of Communication Systems", Taub Schilling, Tata McGraw Hill Fourth Edition.

Reference Books:

1. "Electronic Communication", Dennis Roddy &Coolen, Tata McGraw Hill Publications.
2. "Electronic Communication Systems", Wayne Tomasi, Fourth Edition.
3. "Digital Communications", Simon Haykin, Wiley Publications, Fourth Edition.
4. "Communication Systems", Carlson, McGrawHill, Fourth Edition.
5. "Analog& Digital Communications", Simon Haykin, Wiley Publications.
6. "Digital Communication",B. Sklar, Pearson, Second Edition.

Course Outcomes:

The student will be able to –

1. Differentiate communication channels and noise sources. (CO Attainment level : 4)
2. Analyze amplitude and frequency modulated signal and their spectrum. (CO Attainment level : 3)
3. Illustrate working of analog receivers. (CO Attainment level : 3)
4. Discuss sampling and waveform coding tecgniques. (CO Attainment level : 3)
5. Analyze modulation techniques with respect to bandwidth, Euclidian distance. (CO Attainment level : 2)

6. Evaluate performance of optimum filter. (CO Attainment level : 1)

FF No. : 654

ET2006: Electromagnetic Engineering

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Vector Calculus basics; Gradient, Curl and Divergence; Co-ordinate systems; Coulomb's Law, Electric Field Intensity, Electric flux density, Gauss' law, Electrostatic potential, Boundary conditions, Laplace and Poisson's equations, Capacitance; Biot Savart law, Magnetic flux density, Magnetic field intensity, scalar and vector magnetic potential, Ampere's circuital law, boundary conditions, self inductance, continuity equation.

Section2:

Maxwell equation in differential form, point form, integral form; Phasor concept; time periodic fields; Poynting vector and concept of power flow; Helmholtz equations, Transverse Electromagnetic (TEM) wave, properties of Uniform Plane Wave, Intrinsic impedance; wave propagation ; Behavior of Uniform Plane wave at an interface between ideal medium and ideal conductor, concept of standing wave; Behavior at an interface between two dielectrics; Uniform Plane wave in a good dielectric, Uniform plane wave in a good conductor

Text Books:

1. Engineering Electromagnetics – William Hayt, J.A. Buck, 6th Edition, McGraw Hill publications
2. Elements of Electromagnetics – Matthew Sadiku, 3rd Edition, Oxford University Press

Reference Books:

1. Electromagnetic Waves and Radiating Systems – Pearson Education
2. Electromagnetic Field Theory Fundamentals – Guru, Hiziroglu, Cambridge University Press

List of Tutorials (Any Six):

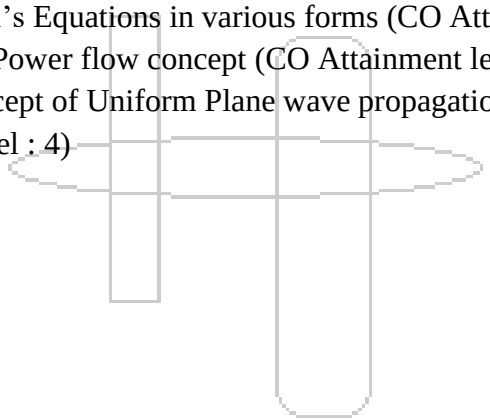
1. Co-ordinate systems and their conversions, Gradient & Divergence
2. Coulomb's Law, Electric Flux Density, Electric field intensity, Gauss' law
3. Electrostatic potential, Boundary conditions, Laplace and Poisson's equations
4. Magnetic flux density, Magnetic field intensity, scalar and vector magnetic potential

5. Ampere's circuital law, boundary conditions
6. Maxwell equation in differential form, point form, integral form
7. Phasor concept; time periodic fields; Poynting vector and concept of power flow
8. Helmholtz equations, Transverse Electromagnetic (TEM) wave, properties of Uniform Plane Wave
9. Intrinsic impedance; wave propagation
10. Behavior of Uniform Plane Wave at various interfaces; Behavior of Uniform Plane wave in a good dielectric & Uniform plane wave in a good conductor

Course Outcomes:

The Student will be able to-

1. Apply knowledge of Vector Calculus (CO Attainment level : 2)
2. Use Boundary conditions and Laplace equations for realization of capacitance (CO Attainment level : 4)
3. Use Boundary conditions and Laplace equations for realization of Inductance (CO Attainment level : 4)
4. Implement Maxwell's Equations in various forms (CO Attainment level : 3)
5. Apply Phasors and Power flow concept (CO Attainment level : 5)
6. Understand the concept of Uniform Plane wave propagation and behavior at interfaces. (CO Attainment level : 4)



FF No. : 654

ET2015: Digital Systems

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1

Binary arithmetic & logic simplification: Binary, Hexadecimal number systems, Inter conversions, 1's complement, 2's complement arithmetic, Binary Coded Decimal codes, Excess-3 Code, Gray code, Standard logic gates, Universal logic gates, Derived gates, Simplification of logic function using Boolean algebra, De Morgan's Theorem, Sum-of-Products and Product-of-Sums forms of Boolean function, NAND and NOR implementation, Canonical and Standard forms, Karnaugh map up to 4 variables.

Combinationalcircuits: Deignprocedureforcombinationallogic circuits,Code conversion,HalfAdder,FullAdder, 4-bitbinary adder,BCDAdder,BCDSubtractor,Paritygenerator,Parity checker, DigitalComparator,Multiplexer andDemultiplexer, their use incombinationallogic designs,multiplexerandDemultiplexertrees,EncoderandDecoder.

LatchesandFlip-flops: Latches and flipflops: SR,D, JK,Master-SlaveJK,andT,useofpresetandclearterminals, schematic symbol,truthtable andexcitationtable,conversionof flipflops.

Section 2

Sequential Circuits: Shiftregisters:SISO, SIPO,PISO,PIPO,bi-directionalshiftregisters, JohnsonandRing counters, designandanalysis of asynchronousandsynchronouscounters,up/downcounters,modulocounters, Pseudo Random BinarySequence(PRBS) generator.

Finite State Machines: Introduction to state machine, Basic Design steps for these sequential circuits using state diagram,StateTable,Stateassignment,finitestatemachine,Mealy machineandMooremachine representationandimplementation,sequence detector,designingvendingmachinebasedonstate machine. Design problems based on finite statemachine.

Logic Families: ClassificationofLogicFamilies:TTL,CMOS,ECL,RTL,I2LandDCTL,Characteristicsof DigitalICs:SpeedofOperation,PowerDissipation,FigureofMerit,Fanin,Fanout,Currentand

VoltageParameters,NoiseImmunity,OperationofTTLNANDgate,Tri- Statelogic,Comparison oflogicfamilies.

List ofPracticals:

1. Design&implement code converters / comparators
2. Design&implementBCD Adder
3. Design&implement combinational logic circuitusingmultiplexer &de-multiplexer
4. Design&implement 3 bit bidirectional shift register using D flip-flop
5. Decade counter output to bedisplayed on 7 segment display
6. Design&implement pulsetraingenerator
7. Design&implement 3 bit up-down ripple counterusingflip-flop
8. Verification ofmod-n counters
9. Design&implement sequencegenerator.
10. Simulation of combinational circuit like Half adder, Full adder, Multiplexer, De multiplexer etc.

List ofProject areas:

1. Applications of Combinational Circuits
2. Applications of Digital Counters
3. Applications of Shift registers
4. Applications of Finite state machines

TextBooks:

1. M. Morris Mano, "Digital Design", Pearson Education, Third Edition
2. Jan M. Rabaey,AnanthaP. Chandrakasan,BorivojeNikolić, "DigitalIntegrated Circuits", Pearson Education, Second Edition 20032.

ReferenceBooks:

1. ThomasLFloyd, "DigitalFundamentals", Pearson Education, 11th Edition
2. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill, 3rd Edition

CourseOutcom es:

Thestudent will be able to–

1. Interpret Binary arithmetic/ logic simplification
2. Designcombinational digital circuits
3. Compare flipflops and latches
4. Design sequential digital circuits
5. Designfinite state machine
6. Comparedifferent parameters of logic families

FF No. : 654

ET2012: Multivariate Data Analysis

Credits: 2 **Teaching Scheme: 2 Hours / Week**

Section 1:

Univariate, multivariate data and data types. Data visualization techniques, box plot, scatter plot, dot plots, 3-D scatter plots, Andrew's curves. Measure of central tendency, dispersion, association, trace, generalized variance. An introduction to multivariate statistical models, Multivariate normal distributions-Multivariate Normal Density Function. Linear combination of random variables Eigen values. Eigen vectors, Principal component analysis: Geometric and Algebraic Bases of Principal Components, Principal Components from the Correlation Matrix, Deciding How Many Components to Retain, Information in the Last Few Principal Components, Interpretation of Principal Components Dimension reduction

Section2:

Linear regression, Multivariate regression: Multiple Regression: Fixed *x*'s, Multiple Regression: Random *x*'s, Multivariate Multiple Regression: Estimation. and Perpendicular Regression,. Discriminant analysis: The Discriminant Function for Two Groups, Discriminant Analysis for Several Groups, Standardized Discriminant Functions, Interpretation of Discriminant Functions. Classification analysis: Classification into Two Groups, Classification into Several Groups, Estimating Misclassification Rates, Improved Estimates of Error Rates, Subset Selection. KNN classifier. Bayes classifier. Cluster Analysis: Measures of Similarity or Dissimilarity, Hierarchical Clustering, Nonhierarchical Methods, Choosing the Number of Clusters,k-means clustering.

Text Books:

1. R.A. Jonhson, D.W. Wichern, "Applied multivariate statistical analysis", Pearson prentice Hall 6th Edition.
2. W.K. Hardle, L. Simer, ""Applied multivariate statistical analysis" Springer

Reference Books:

1. T. Hastie, R. Tibsirani, J. Friedman, "Element of statistical learning: Data mining, inference and prediction", Springer.

Course Outcomes:

The student will be able to –

1. Demonstrate different techniques for visualization of data to draw inference. (CO Attainment level :5)

2. Apply an appropriate technique to achieve dimensionality reduction (CO Attainment level :3)
3. Describe the relationship between two or more independent variables and the dependent variable using regression technique.(CO Attainment level :3)
4. Apply different classifiers to classify the given dada. (CO Attainment level :3)
5. Apply k-means clustering algorithm to form the data clusters. (CO Attainment level :5)
6. Compare and contrast the methods for a given data analysis situation considering the benefits and the pitfalls of the methods. (CO Attainment level : 4)

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(*An Autonomous Institute affiliated to Savitribai Phule Pune University*)

Structure & Syllabus of

T. Y. B. Tech.

(Electronics &Telecommunication Engineering)

Pattern 'C-19'

Academic Year 2019-20

Prepared by: - Board of Studies in E&TC Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

Institute Vision:
To be a globally acclaimed Institute in Technical Education and Research for holistic Socio-economical development

Institute Mission:

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision:
To be a center of Academic Excellence in Electronics, Telecommunication and Related Domains through Continuous Learning and Innovation.

Department Mission:

- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in social context.

Program Educational Objectives (PEOs):
Graduates of the program will

- Have comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real life complex problems
- Be professionals imbibed with a spirit of leadership, ethical behavior and societal commitment
- Be compliant to constantly evolving technology through lifelong learning

Program Outcomes:
Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with

appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Objectives (PSOs)

E&TC Graduates will have Ability to:

1. Design, Develop and Analyze Complex Electronic Systems for Communication, Signal Processing, Embedded Systems and VLSI Applications.
2. Identify and Apply domain specific hardware and software tools to solve real-world problems in Electronics and Communication.

Title: Course Structure **FF No. : 653**

Branch: E&TC **Year: T. Y.** **Academic Year: 2019-20** **Semester: I** **Module: NA** **Pattern: C-19**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
S1	ET3001	Real Time Embedded Systems	3	2	10	30	15	10	15	20	100	4
S1	ET3003	Power Electronics	3	2	10	30	15	10	15	20	100	
S2	ET3005	VLSI Design	3	2	10	30	15	10	15	20	100	4
S2	ET3007	Information Theory and Coding Techniques	3	2	10	30	15	10	15	20	100	
S3	ET3009	Data Communication and Networking	3	2	10	30	15	10	15	20	100	4
S3	ET3002	Digital Signal Processing	3	2	10	30	15	10	15	20	100	
S4	ET3115	Analog Circuits	3	2	10	30	15	10	15	20	100	4
S4	ET3034	Advances in Digital Communication	3	2	10	30	15	10	15	20	100	
S5	ET3027	Engineering Design & Innovation 1	2	4	-	-	50		50	-	100	4
Total												20

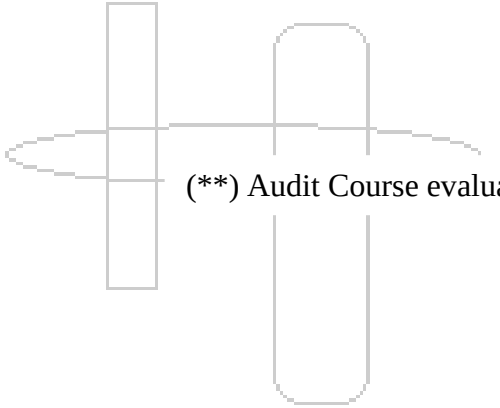
Abbreviations Used	
ISA	In Semester Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment
GD / PPT	Group Discussion / Power Point Presentation

Title: Course Structure **FF No. : 653**

Branch: E&TC **Year: T. Y.** **Academic Year: 2019-20** **Semester: II** **Module: NA** **Pattern: C-19**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
S1	ET3021	Digital Image Processing	3	2	10	30	15	10	15	20	100	4
S1	ET3004	Robotics	3	2	10	30	15	10	15	20	100	
S2	ET3006	Digital Design	3	2	10	30	15	10	15	20	100	4
S2	ET3008	Antenna and Microwave Theory	3	2	10	30	15	10	15	20	100	
S3	ET3012	Machine Learning and Computer Vision	3	2	10	30	15	10	15	20	100	4
S3	ET3024	Object Oriented Programming	3	2	10	30	15	10	15	20	100	
S3	ET3025	Database Management Systems	3	2	10	30	15	10	15	20	100	
S3	ET3010	Biomedical Electronics	3	2	10	30	15	10	15	20	100	
S4	ET3014	Wireless Communication	3	2	10	30	15	10	15	20	100	4
S4	ET3016	Sensors and Internet of Things	3	2	10	30	15	10	15	20	100	
S5	ET3028	Engineering Design & Innovation 2	2	4	-	-	50		50	-	100	4
S6	ET3033	**General Profeciency 3										
Total												20

Abbreviations Used	
ISA	In Semester Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment
GD / PPT	Group Discussion / Power Point Presentation



(**) Audit Course evaluated in second semester

FF No. : 654

ET3001: Real Time Embedded Systems

Credits: 4 **Teaching Scheme: 5 Hours / Week**
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

ARM - Advanced Microcontroller: Structure of ARM7TDMI, ARM Pipeline, ISA Architecture, ARM Buses, THUMB Instructions, Interrupt Handling, Exceptions in ARM, I / O ports, Timers, Interrupts, on-chip ADC, DAC, RTC modules, WDT, PLL, PWM, and I2C Communication Protocols: RS-485, CAN, Profibus, Bluetooth, IEEE 802.11, and USB Hardware Software Partitioning: Partitioning using Integer Programming, Partitioning using Genetic Algorithm, Particle Swarm Optimization, Power aware Partitioning on Reconfigurable Hardware

Section 2:

Real-Time Operating System

Real-Time Tasks, Task Periodicity, Task Scheduling, Clock Driven Scheduling, Event Driven Scheduling, Resource Sharing, Commercial RTOS

Structure of µCOS – II

Kernel Structure, Task Management, Time Management, Semaphore Management, Event Flag Management, Message Mailbox Management, Message Queue Management, Memory Management, and Porting of µCOS- II, Application Development

List of Practicals (Any Six):

1. Interfacing of LEDs
2. LCD & Keypad
3. ADC & DAC
4. UART
5. Task Scheduling for Input and Output Devices (4X4 Keyboard, 16X2 LCD display and ADC) using µCOS- II Semaphore
6. Implementation of Mutual Exclusion, Mailbox and Message Queue for 3 Tasks.

List of Projects (Any One):

1. Design of a Digital Display
2. Touch Screen Control Panel for Stepper Motor
3. Water Level Controller
4. Landmark Recognition
5. Control of 3 Devices using RS-485 Standard
6. Control of 3 Devices using CAN Protocol
7. Control of 3 Devices using Profibus

Text Books:

1. ARM Developers Guide, Sloss Andrew
2. Embedded System Design, CMP Books, Arnold S. Berger
3. Jean J. Labrosse, "MicroC OS II, The Real-Time Kernel", 2nd edition, CMP Books.
4. S. K. Mitra, "Digital Signal Processing- A Computer Based approach," Tata McGraw Hill, 1998.

Reference Books:

1. Embedded / Real Time Systems Programming Black Book, Dreamtech Press, Dr. K.V.K.K. Prasad
2. Embedded System Design – A Unified hardware.
3. Software introduction" 3rd edition, Wiley, Frank Vahid and Tony Givargis.

Course Outcomes:

The student will be able to –

1. Comprehend architecture of ARM processor and its peripheral interfacing. (CO Attainment Level: 3)
2. Implement RS-485, CAN protocols. (CO Attainment Level: 4)
3. Understand approaches to solve hardware-software partitioning problems. (CO Attainment Level: 3)
4. Explain features and policies followed by a Real-Time Operating System. (CO Attainment Level: 3)
5. Explain Structure of UCOS-II. (CO Attainment Level: 3)
6. Apply concepts of system programming to develop real-time embedded system. (CO Attainment Level: 4)

FF No. : 654

ET3003: Power Electronics

Credits: 4 **Teaching Scheme: 5 Hours / Week**
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Power Devices**:-** SCR, Power Diode and BJT, Triac, MOSFET, IGBT- Structure, Characteristics, Selection criterion, Driver Circuits, Protection of power Devices: Snubber circuit, Series & parallel connection of devices.

DC Drives: Controlled bridge rectifiers and its analysis, DC Motors starting, characteristic and speed control, DC drive requirements.

AC Voltage Controllers: Configurations and operation, Applications.

Section2:

AC Drives: Single phase inverters – Working of push pull inverters, full bridge inverter with R and L load, Harmonic analysis of output voltage, Importance of PWM technique for voltage control

Induction motor- Starting, Characteristic and speed control, AC drive requirements.

Switched mode DC/DC Converters: Linear power supplies, switching power supplies without galvanic isolation- step down converters, step up converter, buck boost converter - continuous and discontinuous conduction. Switching dc power supplies with galvanic isolation - fly back converters, forward converters, push pull converters.

Applications: HF induction heating, RF heating, ON- line and OFF line UPS, battery selection and design considerations, Solar Photovoltaic (SPV) system.

List of Practicals (Any Six): (Any 6)

1. Driver circuit for SCR.
2. Single phase Half Controlled (Semi) converter
3. Single phase Fully Controlled (Full) converter
4. AC to AC Converter.
5. Single phase Bridge-inverter
6. MOSFET based PWM Chopper
7. Simulation of power electronic conversion system (AC-DC/ DC-DC), with suitable load.
8. Simulation of power electronic conversion system (DC-AC/AC-AC), with suitable load.
9. Study of SMPS
10. Study of UPS.

List of Projects (Any One):

1. Single phase Power Control (e.g. Fan speed regulator/ Lighting control)
2. Power Supply/Battery charger
3. DC motor speed control
4. Induction motor speed control
5. Emergency lighting system

Text Books:

1. M D Singh & K B Khanchandani, "Power Electronics", 2nd Edition, Tata McGraw Hill.
2. M. H. Rashid, "Power Electronics: Circuits, Devices, and Application", 2nd Edition, Prentice Hall (I)
3. B L Theraja& A K Theraja, "A Text Book of Electrical Technology - AC & DC machines", Volume II, S. Chand.

Reference Books

1. Ned Mohan, Tore Undeland, Williams Robbins, "Power Electronics: Converters, Applications, and Design", 2nd Edition, John Wiley & Sons.
2. P. C. Sen, Modern Power Electronics, S Chand & Co., New Delhi.

Course Outcomes:

The student will be able to –

1. Select power device for given voltage- current specifications. (CO Attainment Level: 3)
2. Analyze DC Drives with controlled converter. (CO Attainment Level: 3)
3. Analyze AC to AC converters. (CO Attainment Level: 3)
4. Analyze AC Drives with inverter. (CO Attainment Level: 4)
5. Analyze, compare and select SMPS configuration. (CO Attainment Level: 3)
6. Select power converters for real life applications. (CO Attainment Level: 3)

FF No. : 654

ET3005: VLSI Design

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

MOSFET: Introduction to MOSFET, MOSFET Capacitor, IV Characteristics, Motivation for Scaling, Types of Scaling, Short channel Effect, Velocity saturation, Mobility degradation, Subthreshold current, Threshold voltage variation, Drain induced barrier lowering (DIBL), Drain punch through, Hot carrier effect, Surface states and interface trapped charge.

Combinational & Sequential Circuits, Semiconductor Memories: SRAM, DRAM cell, Access Time Consideration, ROMs

CMOS Fabrication & Layout: Inverter Cross-section, Fabrication Process – Twin well / Tub Technology, Silicon on Insulator (SOI), N-well / P-well Technology, Layout Design Rules, Gate layouts, Stick Diagrams, CMOS Inverter, CMOS logic Gates, Compound Gates.

Chip input and output circuits: ESD Protection, I/O circuits, On chip clock generation and distribution.

Section 2:

Propagation Delay in CMOS: CMOS Region of operation, Beta-n by beta-p ratio, Pseudo NMOS Inverter (Cascade pseudo NMOS, Saturated pseudo NMOS, Dependence of Propagation delay on Fan-in and Fan-out, RC-Delay, Elmore delay, Parasitic delay, Logical Effort – Basic logic circuits and multistage logic networks

Power Dissipation in CMOS: Effect of power dissipation, Temperature, Dynamic power dissipation - Activity Factor, Capacitance, Voltage, Frequency, Short-Circuit current; Static Power dissipation, multiple threshold voltages and oxide thicknesses, variable threshold voltages, input vectors control; Energy Delay optimization, Low Power CMOS logic circuits

Timing issues in digital circuits: Timing Classification of Digital Systems, Synchronous Interconnect, Synchronous Design, Self-Timed Circuit Design, Synchronizers and Arbiters, Clock Synthesis and Synchronization Using a Phase-Locked Loop.

List of Practicals (Any Six):

1. 2:4 Decoder
2. 3:2 priority encoder
3. 4 - bit adder
4. JK flip-flop
5. DRAM Cell

6. SRAM

List of Projects (Any One):

1. Design static CMOS circuit to realize FIFO / LIFO
2. Design static CMOS circuit to compute F = (A+B)(C+D). Choose transistor sizes to achieve least delay and estimate this delay in T.
3. A static CMOS NOR gate uses four transistors, while a pseudo-nMOS NOR gate uses only three. Unfortunately, the pseudo-nMOS output does not swing rail to rail. If both the inputs and their complements are available, it is possible to build a 3-transistor NOR that swings rail to rail without using any dynamic nodes. Show how to do it.
4. Sketch a 3-input symmetric NOR gate. Size the inverters so that the pulldown is four times as strong as the net worst-case pullup. Label the transistor widths. Estimate the rising, falling, and average logical efforts.

Text Books:

1. Neil H. E. Weste, David Money Harris, CMOS VLSI Design, A circuits and Systems Perspective, Fourth Edition, Addison - Wesley
2. Sung-Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Fourth Edition, Mc Graw Hill

Reference Books:

1. R. Jacob Baker, CMOS: Circuit Design, Layout and Simulation, Third Edition, Wiley
2. Neil H. E. Weste, Kamran Eshraghian,Principles of CMOS VLSI Design, Second Edition, Addison – Wesley
3. Douglas A Pucknell et al, Basic VLSI Design, 3rd Ed., Prenctice Hall, 2004

Course Outcomes:

The student will be able to –

1. Determine MOSFET behavior under dimension scaling. (CO Attainment Level: 3)
2. Design CMOS based logic circuit. (CO Attainment Level: 3)
3. Demonstrate understanding of CMOS fabrication flow. (CO Attainment Level: 2)
4. Analyze delays in CMOS circuits. (CO Attainment Level: 4)
5. Understand power dissipation in CMOS circuits. (CO Attainment Level: 4)
6. Analyze clock signal variations and timing issues. (CO Attainment Level: 5)

FF No. : 654

ET3007: Information Theory & Coding Techniques

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to Information theory, Discrete memory less channel, Entropy and its properties, Differential entropy and mutual Information, Information Capacity theorem.

Kraft‟s McMillan Inequality, Source coding theorem, Huffman coding, Shannon-Fano coding, Arithmetic Coding, Dictionary Techniques for lossless compression, Linear Block Codes- Syndrome and error detection, Error detection and correction capacity, Standard array and syndrome decoding, Encoding and decoding circuit, Single parity check codes

Section 2:

Cyclic Codes, generator polynomial, Generator matrix for systematic cyclic code, Encoding for cyclic code, Syndrome decoding of cyclic codes, Convolutional Codes, State diagram, Polynomial description of convolution code, Generator matrix of convolution code, Tree diagram, Trellis diagram, Viterbi decoding, Binary BCH code, Generator polynomial for BCH code, Decoding of BCH code, RS codes, generator polynomial for RS code, Decoding of RS codes.

List of Practicals (Any Six):

1. To determine Entropy and information rate for the given source.
2. To implement Huffman code.
3. To implement arithmetic code.
4. To implement LZ77 algorithm.
5. To implement LZ77 algorithm.
6. To implement LZW algorithm
7. To implement linear block codes.
8. To implement cyclic code.
9. To implement convolution code.
10. To implement Viterbi decoder

List of Projects (Any One):

1. Signal/Image compression with lossless/lossy compression techniques.
2. Text files compression with dictionary techniques.

3. Comparison of various channel coding Techniques.

Text Books:

1. "Information Theory coding and Cryptography" ,RanjanBose , 2ndEdition ,McGraw-Hill Publication.
2. "Analog and digital communications", Hwei Hsu, second edition , Schaum"s outlines.

Reference Books:

1. "Digital Communication Fundamentals & applications"; BernadSklar, Second Edition , Pearson Education.
2. "Communication Systems", Simon Haykin; Fourth Edition, John Wiley & Sons.
3. "Introduction to Data compression", Khalid Sayood; Morgan Kaufmann Publisher.

Course Outcomes:

The student will be able to –

1. Evaluate the performance of source coding theorem based on entropy. (CO Attainment Level: 2)
2. Analyze & implement lossless compression techniques. (CO Attainment Level: 2)
3. Analyze linear block codes for error detection. (CO Attainment Level: 2)
4. Decode cyclic code for error detection. (CO Attainment Level: 2)
5. Generate Convolutional code & decode using Viterbi decoding. (CO Attainment Level: 3)
6. Analyze RS code. (CO Attainment Level: 3)

FF No.: 654

ET3009: Data communication and Networking

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Network Architecture and OSI reference model

Introduction to Computer Networks, Topologies, Types of Networks, Layered Architecture of Computer Networks, OSI reference model, functions of each layer

Channel and MAC, Types of Channels, Signaling methods, Channel accessing methods, Error control and Flow control.

TCP/IP Protocol Suite: Introduction, Layers of TCP/IP protocol suite: Physical and Data Link Layers, Network Layer: Addressing, Ipv4 Addresses, Transport Layer: Process-to-Process Delivery, UDP, TCP, Application Layer.

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Section 2:

LAN and WAN

Introduction to Local Area Networks, IEEE Standards for LANs, Wired LANs, Wireless LANs: IEEE 802.11, Channel Access Methods, Fast Ethernet, Gigabit Ethernet. SONET/SDH, Frame Relay, ATM, Wireless WANs

Network Management and Security

Network Management System, Network Management protocols, Network Security

Network applications and protocols

File transfer protocol, E-mail and the Web, multimedia applications such as IP telephony and video streaming- Overlay networks like peer-to-peer file sharing and content distribution networks- Web Services architectures for developing new application protocols.

List of Practicals (Any Six):

1. Prepare and test a straight through and crossover cable.
2. Implement a LAN for file/printer sharing
3. Implement Sliding window protocol
4. Implement Error correction and checking methods.
5. Design a client server environment to implement a web application.
6. Design a client server environment to implement a File transfer application.
7. Implement substitution and transposition algorithms

8. Implement a RSA algorithm
9. Implement a network and study for routing
10. Implement a network and study for addressing mechanism.

List of Projects (Any One):

1. Implementation of flow control protocols
2. Implementation of ARQ protocols
3. Design of a LAN for given conditions
4. Design of WAN for given condition
5. Implement a network and debus using network tools.
6. Development of Applications.

Text Books:

1. Computer Networks (3rd edition), Tanenbaum Andrew S., International edition,
2. Data communication and networking (4th edition), Behrouz A Forouzan, McGraw – Hill.

Reference Books:

1. Data and computer communication by William Stallings.
2. Computer Networking, James kurose& Keith Ross. , Low Price Edition.

Course Outcomes:

The student will be able to-

1. Describe OSI reference Model. (CO Attainment Level: 1)
2. Design physical and data link layer functions and protocols of OSI model. (CO Attainment Level: 2)
3. Analyze the TCP/IP Protocol Suite. (CO Attainment Level: 3)
4. Design Local Area Networks and Wide Area Networks. (CO Attainment Level: 3)
5. Describe management functions and security algorithms. (CO Attainment Level: 2)
6. Develop application layer protocols. (CO Attainment Level: 4)

FF No. : 654

ET3002: Digital Signal Processing

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing. Discrete Fourier transform, DFT properties, computation of linear convolution using circular convolution, Linear filtering using overlap add and overlap save method, FFT algorithms, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Goertzel algorithm, Z transform, relation between Laplace transform and Z transform, relation between Fourier transform and Z transform, properties of Z transform, relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform.

Section 2:
Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form and cascade form. Finite word length effect in FIR filters design. Design of IIR filters from analog filters, Impulse invariant method, relationship between analog and digital frequencies, Bi-linear Transformation Method, comparison of Impulse-variance and Bi- linear Transformations, IIR filter specifications, Realization of IIR filters-Direct I and Direct II form structure, cascade structure, Parallel form structure. Introduction to lattice structure. Introduction to multirate signal processing: Interpolation, decimation, implementation of sampling rate conversion: ployphase filter structure.

List of Practicals (Any Six):

1. Perform discrete time signal analysis using FFT.
2. To perform linear convolution of two sequence using DFT.
3. To filter the long data sequence using overlap add/save algorithm.
4. To determine z-transform from the given transfer function and its ROC
5. Test discrete time systems for stability and causality using Z-transform.

6. Implement different window functions and observe the effect of different windows on FIR filter response.
7. Design Butterworth filter (IIR) using bilinear transformation method and plot its frequency response.
8. To analyze coefficient quantization effects on the frequency response of an IIR filter.
9. Design sampling rate converter for given specification.
10. Design an appropriate filter to extract the information from noisy signal.

List of Projects (Any One):

1. ECG Signal Analysis
2. Speech Enhancement using Spectral Subtraction Method
3. Musical Instrument Identification
4. Audio Equalizer
5. Speech Recognition
6. DTMF Encoder and Decoder
7. Correcting the geometrical orientation of text in an image using discrete Fourier transform
8. Real time filtering using overlap-save or overlap-add method
9. Audio Effects Generation
10. Voice Activity Detector

Text Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing-Principles, algorithms and applications," PHI, 1997.
2. E.C. Ifeachor and B.W. Jervis, "Digital signal processing – A practical approach," Pearson Edu., 2nd edition, 2002.
3. S. K. Mitra, "Digital Signal Processing- A Computer Based approach," Tata McGraw Hill, 1998.

Reference Books:

1. Ramesh Babu, "Digital Signal processing," Scitech publications, 2001.
2. Shalivahanan, Vallavraj, Gnanapriya C., "Digital Signal Processing," TMH, 2001.
3. Li Tan, Jean Jiang, "Digital Signal Processing: Fundamentals and applications," Academic press.

Course Outcomes:

The student will be able to –

1. Apply DFT to analyze discrete time signals. (CO Attainment Level: 2)
2. Compare computational complexity of DFT and FFT algorithm. (CO Attainment Level: 3)
3. Analyze LTI systems using Z-transform. (CO Attainment Level: 3)
4. Design linear phase FIR filter of given Specifications. (CO Attainment Level: 4)

5. Design IIR filter of given Specifications from equivalent analog filter. (CO Attainment Level: 4)
6. Implement sampling rate converter. (CO Attainment Level: 5)

FF No.: 654

ET3115: Analog Circuits

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Feedback Amplifiers and Oscillators

Introduction to concept of feedback, Negative feedback, Topologies of feedback-voltage-series, current-series, voltage shunt and current shunt, Effect of feedback on gain, input impedance, output impedances & bandwidth of an amplifier, Analysis of feedback topology, positive feedback, oscillators, RC phase shift and Wien bridge oscillator.

Power Amplifiers

Classes of power amplifiers, Class A, Class B, Class AB, Class C and Class D amplifiers, Analysis of Class A, Class B, Class AB amplifiers, Distortion in amplifiers, Total Harmonic Distortion (THD), Comparison of power amplifiers

Fundamentals of Op-amp

Introduction to operational amplifier, block diagram, differential amplifier, current sources like constant I-source, I-mirror, Widlar current source, level shifters, op-amp configurations, ideal and practical op-amp, op-amp parameters like input offset voltage, output offset voltage input offset current, input bias current, CMRR, slew rate, small signal and power bandwidth,

Section 2:

Linear Applications of op-amp

Summing amplifier, Difference amplifier, Voltage follower, Integrator, Differentiator, V-I converter, I-V converter, log amplifier, antilog amplifiers, temperature compensated log circuits, log ratio amplifier, Instrumentation amplifier.

Non-Linear Applications of op-amp

Comparators, Op-amp as comparator, Limitations of op-amp as comparator, Window comparator, Schmitt Trigger, Wave shaping circuits, Precision half wave and full wave rectifiers, peak detector, sample and hold circuit.

Waveform Generators
Astable, mono-stable and bi-stable multivibrators, waveform generators like sine, square, rectangular, pulse, triangular, saw tooth and ramp.

List of Practicals (Any Six):

1. Series Feedback Amplifier
2. Shunt Feedback Amplifier
3. Wien Bridge Oscillator
4. Op-amp Parameters
5. Design and testing of Integrator Circuit
6. Design and testing of Differentiator Circuit
7. Design and testing of V to I & I to V Converters
8. Design and testing of Schmitt Trigger circuit
9. Design and testing of Precision Half Wave and Full Wave Rectifier
10. Design and testing of Astable Multi-vibrator
11. Design and testing of Mono-stable Multi-vibrator
12. Design and testing of Waveform Generator

List of Projects (Any One):

1. Develop analog computer prototype
2. Water/Temperature level detector
3. Design and develop instrumentation amplifier
4. Applications of V-I Converters
5. Applications of I-V Converters
6. Applications of open loop/closed loop comparators
7. Develop function generator with specified parameters
8. Develop applications of Window comparator
9. Develop applications of Wave shaping Circuits
10. Develop triggering circuit
11. Develop audio control circuit
12. Develop absolute value Circuits

Text Books

1. D. Roy Choudhary, „Linear Integrated Circuits", 4th edition, New age
2. Ramakant Gaikwad, „Op amps and linear integrated circuits," 4th edition, PHI.

Reference Books

1. Sergio Franco, „Design with operational amplifiers and analog integrated circuits", TMH, 3rd edition.
2. Coughlin and Discroll,"operational amplifiers and linear integrated circuits," 6th Edition, PHI.

Course Outcomes

The students will be able to

1. Illustrate fundamentals of op-amp in terms of block diagram. (CO Attainment Level: 3)
2. Apply knowledge about parameters in practical applications. (CO Attainment Level: 2)
3. Design linear applications of op-amp. (CO Attainment Level: 3)
4. Design non-linear applications of op-amp. (CO Attainment Level: 3)
5. Develop function generator circuits. (CO Attainment Level: 3)
6. Design phase locked loop applications. (CO Attainment Level: 4)

FF No.: 654

ET3034: Advances in Digital Communication

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section1:

Linear modulation Techniques: Binary phase shift keying, Quadrature phase shift keying, π/4 QPSK , π/4 DQPSK , QAM.

Nonlinear modulation techniques: Continuous phase modulation-Minimum shift keying, Gaussian -filtered MSK.

Mathematical representation of noise, noise calculations ,Impact of noise on Pulse code modulation and delta modulation, Probability of error for modulation techniques .

Section2:

Channel Equalization: Fundamentals of equalization , Linear and Non Linear Equalization Techniques , Adaptive equalizer

Spread –Spectrum Modulation: Pseudo noise sequences, Gold codes , Direct sequence spread spectrum with coherent Binary phase shift keying, Signal Space dimensionality and processing gain, Probability of error, Frequency hop spread spectrum.

Multiple Access Techniques: Time Division Multiple Access ,Frequency Division Multiple Acess,Code Division Multiple Access,Orthogonal Frequency Division Multiple Access.

List of Practicals:

Implementation of

1. Quadrature phase shift keying
2. π/4 shifted Quadrature phase shift keying.
3. Pseudo noise sequence generation.
4. Direct sequence spread spectrum with coherent Binary phase shift keying.
5. Zero forcing equalizer
6. Code Division Multiple Access.

List of Project areas:

1. TDMA,FDMA,CDMA
2. FHSS
3. OFDM
4. Channel Equalisation

Text Books

1. Communication Systems -Simon Haykin, Fourth edition ,Wiley.
2. Principles of Communication Systems ,Taub Schilling ,Second edition, McGraw -HILL

Reference Books

1. Wireless Communications- Principle and practice- Theodore S, Rappaport, Pearson.
2. Digital communications -Fundamentals and applications –Bernard Sklar, Prentice Hall

Course Outcomes:

The student will be able to –

1. Understand the concept of linear modulation techniques
2. Understand the concept of non-linear modulation techniques
3. Analyze impact of noise on of digital communication systems
4. Understand the role of equalization to improve radio link performance
5. Perform analysis of spread spectrum techniques.
6. Understand the concept of multiple Access techniques for wireless communication.

FF No. : 654

ET3021: Digital Image Processing

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Prerequisite: Students are expected to have knowledge in linear signals and systems, 1-D Fourier Transform, basic linear algebra, basic probability theory and basic programming techniques; knowledge of Digital Signal Processing is desirable.

Section 1:

Introduction to FFT and Digital Filters, Elements of visual perception, Image sampling & Quantization, Basic grey level transformations, histogram processing, enhancement using arithmetic and logic operators, spatial filtering – smoothing and sharpening filters, Median Filter, Inter pixel and image redundancy, 2-D Discrete Fourier Transform and Discrete Cosine Transform, Walsh Hadamard Transform, Fast Walsh Transform, Wavelet Transform, Hough Transform ,Neighborhood concepts, adjacency and distance measures, dilation & erosion, opening & closing operations, basic morphological operations such as region filling, thinning, thickening, skeletons, Morphological operations for gray scale images

Section2:

Detection of discontinuities, edge linking and boundary detection, thresholding, Region based segmentation, use of watersheds, image representation- chain codes, boundary descriptors Compression Fundamentals, Image Compression Models, Error Free Compression, Lossless Predictive Coding, Lossy Predictive Coding, Image Compression Standards – Baseline JPEG, Various Noise Models, Inverse and Wiener Filtering, Image Registration, Mutual Information, Maximum entropy restoration

List of Practicals (Any Six):

1. Image quantization, bit plane slicing
2. Image histogram and thresholding

3. Image enhancement
4. Image filtering
5. Edge detection
6. Mathematical, logical operations
7. Morphological operations
8. Application of DFT, DCT
9. Inverse & Wiener filtering
10. Image Registration & Mutual Information

List of Projects (Any One):

1. Watershed based segmentation
2. Enhancement and thresholding of medical image
3. Currency recognition
4. Vehicle number plate extraction
5. Count number of similar objects in an image
6. Noise removal
7. Detection of annual rings in wood

Text Books:

1. Digital Image Processing, Gonzalez, Woods, Prentice Hall India, 2nd edition
2. Digital Image Processing, Pratt W.K., John Wiley, 2001

Reference Books

1. Fundamentals of Digital Image Processing, Jain A.K., Prentice Hall India, 1997
2. Image Processing, Analysis & Machine Vision, Milan Sonka, Thomson Publication

Course Outcomes:

The Student will be able to-

1. Perform various enhancement operations. (CO Attainment Level: 3)
2. Analyze image using morphological techniques. (CO Attainment Level: 2)
3. Apply segmentation techniques to divide image into parts. (CO Attainment Level: 4)
4. Use various image transforms to analyze and modify image. (CO Attainment Level: 5)
5. Apply image compression approaches. (CO Attainment Level: 3)
6. Apply image registration techniques. (CO Attainment Level: 4)

FF No.: 654

ET3004: Robotics

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Basics of Robot :Specification of a Robot, Classification of Robots, Robot Components, Robot Degree of Freedom, Robot Coordinates, robot Programming, applications. Robot kinematics: Position and orientation representations, homogeneous transformations, frames, D- H convention, forward kinematics, inverse kinematic. Robot Sensors: Classes of tactile and non-tactile sensors, working principles, mathematical modelling of sensors, multi-sensor integration, control issue.

Section2:
Robot Actuators: Classes of robot actuators, working principles, mathematical modelling of actuators, mechanical construction and control issues. Path Planning:Path types, point-to-point-motion, continuous path motion, spline interpolation, trajectory planing.Robot Programming:Hardware and software architectures of robot controllers, robot programming paradigms, robot programming languages.

List of Practicals (Any Six):
1. Simulation of degree of freedom
2. Simulation of homogeneous transformation
3. Simulation of forward and inverse kinematic
4. Interfacing of proximity sensor with microcontroller
5. Interfacing of actuator with microcontroller
6. Simulation of point-to-point motion
7. Simulation of continuous path motion
8. Simulation of joint space trajectory trajectory
9. Simulation of Cartesian space trajectory

10. Simulation of joint space trajectory with via-points

List of Projects (Any One):

1. Harvest bot
2. Pick and place bot
3. Wall follower Bot
4. Maze solver bot
5. Obstacle avoidance bot
6. Line follower bot

Text Books:

1. John J. Craig *"*Introduction to robotics: Mechanics and Control*",* Prentice Hall, 2004.
2. P. M. John, "Introduction to robotics", Wesley, 1991.
3. M. W. Spon, M. Vidyasagar, "Robot Dynamics and Control", Wiley and Sons, 1996.

Reference Books:

1. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, "Robotics: Control, Sensing, Vision and Intelligence", McGraw Hill Education (India Ed.).
2. T. R. Kurfess, "Robotics and Automation Handbook", CRC Press.

Course Outcomes:

The student will be able to –

1. Translate specifications to the components of robots such as arms, linkage, drive system and end effector. (CO Attainment Level: 2)
2. Understand the mechanics and kinematics of robot. (CO Attainment Level: 4)
3. Select sensors for a given applications. (CO Attainment Level: 3)
4. Demonstrate use of engineering methods and problem solving toward design of specified robot. (CO Attainment Level: 4)
5. Use robot operating system for application development. (CO Attainment Level: 3)
6. Apply pre-requisite knowledge of programming, microcontroller, sensor interfacing, and operating system for development of robot. (CO Attainment Level: 4)

FF No. : 654

ET3006: Digital Design

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Reconfigurable hardware

Design options for digital systems, Standard Chips, PLDs, FPGAs and ASICs. VLSI design flow. Role of hardware description languages, motivation. Concurrency in hardware, Concept of delta delay. Concept of Micro architecture.

Introduction to Verilog HDL: Levels of Design Description, Concurrency. Verilog Language Constructs and Conventions: Introduction, Keywords, Identifiers, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Operators

Gate Level Modeling: Introduction, Module Structure, Gate Primitives, Tristate buffers, Design of Flip-Flops with Gate Primitives, Net Types, Delay models.

Switch level modeling: MOS switches, CMOS switch, bidirectional switch.

Dataflow Modeling: Introduction, Continuous Assignment Structure, Delays and Continuous Assignments, Assignment to Vector, Operators, user defined primitives.

Test bench: Self checking test bench

Behavioral modeling: Procedural constructs- initial & always block, procedural assignments – blocking and nonblocking statements, difference in blocking and nonblocking statements, active region, inactive region, event scheduling under stratified event queue, event scheduling in Verilog, delay timing control, selection statements- if-else, case, iterative statements- while, for, repeat, forever loop.

Section 2:

Datapath and control path elements: Use of Tasks and functions to design FSM, Subsystem Design, Shifters, Adders, ALUs, Multipliers, Parity generators, Comparators, Zero/One Detectors, Counters, RAM, ROM.

Synthesis: Latch inference, code optimization, Coding guidelines for clocks and resets. High Level Synthesis.
Verification: Functional verification, formal and simulation based, test bench design, clock signal generation, reset signal generation, verificational coverage, Dynamic timing analysis, static timing analysis.

List of Practicals (Any Six):

1. To demonstrate the use of gate level modeling (FA)
2. To demonstrate the use of dataflow modeling (MUX , DMUX, LATCH)
3. To demonstrate the use of behavioral modeling (always statement, blocking &non blocking
4. statements, case statement, combinational circuit description) (MUX, DMUX, decoder, encoder, parity detector)
5. To demonstrate the use of behavioral modeling (always statement, case statement, combinational circuit description) (ALU, code converters)
6. To demonstrate the use of behavioral & structural modeling (flip flop, shift registers)
7. To demonstrate the use of behavioral modeling (up-down counter)
8. To demonstrate the use of behavioral modeling (consecutive ones counter)
9. To demonstrate the use of behavioral modeling (state machine based system)
10. To demonstrate the use of behavioral modeling (RAM, ROM)
11. To demonstrate the use of behavioral modeling (Multipliers, adders)

List of Projects (Any One):

Project based on design, verification and synthesis of functionality like I2C protocol, SPI protocol, RAM, FIFO, vending machine etc.

Text Books:

1. Samir Palnitkar; Verilog HDL; 2nd Edition, Pearson Education, 2009
2. Michel D. Ciletti; Advanced Digital Design with Verilog HDL; PHI, 2009

Reference Books:

1. ZainalabdienNavabi; Verliog Digital System Design; 2nd Edition, TMH
2. Stephen Brown, ZvonkocVranesic; Fundamentals of Digital Logic with Verilog Design; 2nd Edition, TMH
3. Sunggu Lee; Advanced Digital Logic Design using Verilog, State Machines & Synthesis for FPGA; Cengage Learning, 2012.

Course Outcomes:

The student will be able to –

1. Explain VLSI design flow and basics of Verilog HDL. (CO Attainment Level:2)
2. Develop functionality of combinational circuits using Verilog HDL. (CO Attainment Level:3)

3. Develop functionality of sequential circuits using Verilog HDL. (CO Attainment Level:3)
4. Propose breaking up of large procedures into smaller ones to make it easier to read and debug the source description. (CO Attainment Level:4)
5. Choose Verilog HDL statement for coding and synthesis optimization. (CO Attainment Level:4)
6. Test and verify the functionality described by Verilog HDL. (CO Attainment Level:5)

FF No. : 654

ET3008: Antenna and Microwave Theory

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section1:

Fundamental Concepts of Antennas:

Overview of Maxwell‟s Equation for time varying fields, Poynting‟s Theorem , Retarded Potential, Physical concept of radiation, Fields associated with Hertzian dipole, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Radiation from Wires and Loops & Aperture Antennas

Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Huygens‟ principle, radiation from rectangular and circular apertures.

Microwave Transmission Lines

Overview of Microwave communication: Microwave communication system , Advantages and applications of Microwaves. Rectangular Waveguides – TE/TM mode analysis, Expressions for Fields, Characteristic Equation and Cut-off Frequencies, Dominant Modes. Mode Characteristics – Phase velocity and Group Velocity. Power Transmission and Power Losses in Rectangular Waveguide.

Section 2:

Waveguide Components and Applications

Cavity Resonators– Introduction, Rectangular and Cylindrical Cavities, Dominant Modes and Resonant Frequencies, Waveguide Multiport Junctions – E plane Tee, Magic Tee.

Ferrite Components – Gyrator, Isolator. Scattering Matrix– Significance, Formulation and Properties, Microwave Tubes, Limitations and Losses of conventional tubes at microwave frequencies.
Microwave tubes – O type and M type classifications.
O-type tubes : 2 Cavity Klystrons – Structure, Velocity Modulation Process and Applegate Diagram, Bunching Process , Expressions for o/p Power and Efficiency.
HELIX TWTS: Significance, Types and Characteristics of Slow Wave Structures; Structure of TWT , Expressions for o/p Power and Efficiency.
M-type Tubes: Introduction, Cross-field effects, Magnetrons – Different Types, 8-Cavity Cylindrical Travelling Wave Magnetron – Hull Cut-off, Modes of Resonance and PI-Mode Operation, o/p characteristics.
Microstrip Antennas: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

List of Practicals (Any Six):

1. Simulate antenna using HFSS software
2. Design and simulate of antenna arrays
3. Study of Microwave components
4. Study the characteristics of Reflex klystron
5. Study V-I characteristics of Gunn diode.
6. Study port parameters of Magic Tee.
7. Plot radiation pattern of Horn antenna using microwave bench.
8. Study port parameters of Circulator
9. Calculate port parameters of Circulator
10. Calculate Directivity, Coupling factor and insertion loss for 10 dB / 20 dB Directional Coupler

List of Projects (Any One):

1. Design and simulate yaggi antenna
2. Design and simulate patch antenna
3. Design and simulate parabolic antenna
4. Design and simulate Horn antenna
5. Design and simulate dipole antenna
6. Wireless power transmission

Text Books:

1. Microwave Devices and Circuits – Samuel Y. Liao, PHI, 3rd Edition .
2. Micro Wave and Radar Engineering – M. Kulkarni, Umesh Publications
3. Antenna and Wave Propagation - K.D. Prasad, Satya Prakashan

Reference Books:

1. Elements of Microwave Engineering – R. Chatterjee, Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
2. Microwave Engineering Passive Circuits – Peter A. Rizzi, PHI, 1999
3. Antennas For All Applications – John D.Kraus,3rd Edition
4. Antenna and wave propagation - A. R. Harish, M, Sachidananda

Course Outcomes:

The student will be able to –

1. Analyze antenna measurements to assess antenna‟s performance. (CO Attainment Level: 4)
2. Know the concept of radio wave propagation. (CO Attainment Level: 3)
3. Analyze microwave channel mathematically. (CO Attainment Level: 2)
4. Analyze microwave components mathematically. (CO Attainment Level: 3)
5. Interpret microwave sources mathematically. (CO Attainment Level: 2)
6. Illustrate the different types of arrays and their radiation patterns. (CO Attainment Level: 2)

FF No. : 654

ET3012: Machine Learning and Computer Vision

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Human Vision System, Computer Vision System, Camera Geometry Fundamentals, Feature detection, feature extraction – representation and attributes, image representation – chain code, polygonal approximation, object description – boundary and region description, Image registration – feature matching, geometric transformation, mapping

Section2:

Introduction to machine learning, Linear Regression, Linear Classification, Bayesian Learning and Decision Trees, Linear Discriminant analysis, Support Vector machines, Evaluation Measures and learning models, Clustering, Reinforcement Learning, ANN: perceptron and BP algorithm

List of Practicals (Any Six):

1. Implementation of SIFT / HOG object detector
2. Implement KNN classifier
3. Implement object tracking
4. Implement image registration
5. Implement Naïve Bayes classifier
6. Implement chain code representation
7. Implement k means clustering
8. Implement SVM classifier

9. Neural Networks and Perceptron Example
10. Multilayer Perceptron and Application

List of Projects (Any One):

1. Naïve Bayes classification based projects.
2. Perceptron and linear SVM based projects.
3. Linearly non discriminant data based projects.
4. Clustering technique based projects.

Text Books:

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer Publication.
2. Forsyth and Ponce, "Computer Vision-A Modern Approach", 2nd Edition, Pearson Education.
3. R. O. Duda, P.E.Hart, and D.G.Stork,", Pattern Classification", 2nd edition, Springer, 2007.
4. Theodoridis and Koutrombas," Pattern Recognition", 4th edition, Academic Press, 2009

Reference Books

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis, and Machine Vision", Thomson Learning.
2. Robert Haralick and Linda Shapiro, "Computer and Robot Vision", Vol I, II, Addison-Wesley, 1993.
3. Ludmila I.Kuncheva,"Combining pattern classifiers", John Wiley and sons Publication.
4. EthemAlpaydin,"Introduction to Machine Learning",The MIT press.

Course Outcomes:

The student will be able to-

1. Develop feature vectors for object detection purpose. (CO Attainment Level: 2)
2. Select algorithm for object recognition. (CO Attainment Level: 3)
3. Discuss image registration techniques. (CO Attainment Level: 3)
4. Discuss the concept of machine learning. (CO Attainment Level: 2)
5. Classify data/ signal using supervised classifiers. (CO Attainment Level: 3)
6. Classify data/ signal using unsupervised classifiers. (CO Attainment Level: 4)

FF No. : 654

ET3024: Object Oriented Programming

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week

Lab/ Project: 2 Hours / Week

Section 1:

Overview of C, I/O and Loop, Arrays and Strings, Sorting and Searching, Constants and Inline Functions, Reference and Pointers, Default Parameters and Function Overloading, Operator Overloading, Dynamic Memory Management, Classes and Objects, Access Specifiers, Data Encapsulation, Constructors, Destructors and Object Lifetime, Copy Constructor and Assignment Operator, Const-ness, Static Members, friend Function and friend Class, Overloading Operator for User Defined Types, Inheritance.

Section2:

Polymorphism, Dynamic Binding, Virtual Function Table, Type Casting and cast operators, Multiple Inheritance, Exceptions, Error Handling, Templates: Function Template, I/O streams, File Handling, Threading.

List of Practicals (Any Six):

1. Structures and Unions in C
2. Different Functions and Call Mechanism: Call by Value and Call by Reference
3. Inline Functions
4. Storage Specifiers
5. Constructors and Destructors
6. Multiple Inheritance: Access Specifiers
7. Friend Function and Friend Class

8. Class Template

List of Projects (Any One):

1. Creating Signal Processing Libraries
2. Test Case Generator
3. Call Graph Generation
4. Parallel memory address generation

Text Books:

1. E. Balagurusamy; "Object oriented programming with C++"; 4th Edition, Tata McGraw-Hill
2. Bjarne Stroustrup, ―The C++ Programming language, Third edition, Pearson Education. ISBN 9780201889543.

Reference Books:

1. R. Lafore; "The Waite Group's object oriented Programming in C++"; 3rd Edition, Galgotia
   Publications
2. Herbert Schildt, "C++ The complete reference", Eighth Edition, McGraw Hill

Course Outcomes:

The student will be able to –

1. Design classes, function and data structures for applications. (CO Attainment Level: 2)
2. Make use of Operator Overloading concepts. (CO Attainment Level: 3)
3. Apply the concepts of data encapsulation and inheritance. (CO Attainment Level: 3)
4. Create a virtual function for derived class. (CO Attainment Level: 3)
5. Create solutions to a problem by applying the knowledge of Exception handling. (CO Attainment Level: 4)
6. Design an application using File handling. (CO Attainment Level: 5)

FF No. : 654

ET3025: Database Mangement System

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:
Course Overview. Introduction to RDBMS , Structured Query Language (SQL) , Relational Algebra. Entity-Relationship Model , Relational Database Design

Section2:
Application Development. Case Studies. Storage and File Structure , Indexing and Hashing. Query Processing, Query Optimization. Transactions (Serializability and Recoverability) , Concurrency Control. Recovery Systems. Course Summarization.

List of Practicals(Any Six):

1. Implementation of DDL commands of SQL
2. Implementation of DML commands
3. Implementation of functions in SQL
4. Implementation of operators in SQL
5. Study and implementation of different types of JOINS
6. Study and implementation of different types clause
7. Study and implementation of sub queries and views
8. Study and implementation of SQL queries (creating database/table and managing users)
9. Study and implementation of PL/SQL
10. Study of standard database models

List of Project areas(Any One):

1. Student information system
2. Library management
3. Courier service
4. Hospital management
5. Employee database management
6. MSRTC database management
7. Inventory database management
8. Exam database management

Text Books:

1. Database System Concepts by Abraham Silberschatz , Henry F. Korth, and S. Sudarshan, 6th Edition, McGraw-Hill Education.

Reference Books:

1. Database Management Systems, 3rd Edition By Raghu Ramakrishnan and Johannes Gehrke , MGH Education
2. Database Management Systems, 1st Edition, Authors: Michael M. Gorman, Imprint: Butterworth-Heinemann

Course Outcomes:

The student will be able to

1. Examine data structures, file organizations, concepts
2. Understand principles of DBMS‟s, data analysis, database design, data modeling,
3. Understand database management, data & query optimization, and database implementation.
4. Study relational data models; entity-relationship modeling, SQL, data normalization, and database design.
5. Practice query coding using MySQL (or any other open system) through various assignments.
6. Design simple multi-tier client/server architectures based and Web-based database applications .

FF No. : 654

ET3010: Biomedical Electronics

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Diagnostic and Therapeutic Equipment: Cardiac Life support Equipment, Respiratory Care Equipment, ICU & Life Support Equipment, Haemodialyzers and Lithotripters, Diathermy and Radiotherapy. Medical device regulations and standards.

Cardiological Signal Processing:

Automated ECG analysis. QRS detection methods. Rhythm analysis. Arrhythmia detection algorithms. ECG pattern recognition. ECG acquisition and transmission. Noise canceling methods to enhance ECG monitoring.

Neurological Signal Processing:

Modeling of EEG signal. Linear production. Detection of spike and spindles. Detection of alpha, beta and gamma waves. Modeling of seizure EEG. Sleep stages.

Section 2:

Radiography: X-Ray, generation of CT, spiral CT, mammography, computed radiography (CR). Magnetic resonance imaging: image acquisition and reconstruction, fast imaging methods, functional imaging, FMRI

Ultrasonic Imaging and Nuclear Imaging: Generation and detection of ultrasound, B-mode, M-mode TM-mode processing, Data acquisition and reconstruction of Doppler image, pulsed wave Doppler, NMI-Radioactive decay modes, data acquisition.

Medical Optics: Optical properties of tissues, Biophotonic Diagnostics: optical biosensors, glucose analysis, flowcytometry, cellular tissue imaging, Optical Coherence Tomography. Photodynamic therapy applications: LASER tissue welding, LASER in dermatology, neurosurgery, ophthalmology and urology.

List of Practicals (Any Six):

1. Determination of Heart Axis by measuring QRS amplitude in the different leads (Lead I, Lead II and Lead III) and Plotting Einthoven Triangle.
2. To study and testing of ECG signal
3. To study and testing of EEG signal
4. Study, Design and measurement of respiration rate using different sensors.
5. Spectrum analysis & Noise removal of biomedical signals.
6. Algorithm for Adaptive Noise Canceling.
7. Implementation of Template matching algorithm for QRS detection.
8. Implement algorithm for Classification of EEG waves.
9. To measure the components in EEG Signal and Heart Rate Variability in ECG signal simultaneously to understand the inter-relations amongst various physiological parameters
10. Segmentation of lesions from the biomedical images

List of Projects (Any One):

1. Design a Heart rate meter
2. Design a SpO2 sensor.
3. Design PFT sensor
4. Design and testing of Electronic stethoscopes.
5. Design and testing of Electronic Blood Pressure Meters
6. Design, testing and calibration of Digital pH meter using glass electrode.

Text Books:

1. Khandpur R. S., Handbook of Bio-Medical Instrumentation, Tata McGraw Hill, 2nd Ed., 2003.
2. Joseph J.Carr and John M. Brown, Introduction to Biomedical equipment technology, John Wiley and sons, New York, 1997
3. Willis J. Tompkins, Biomedical Digital Signal Processing, Prentice-Hall, 1993.
4. S Webb, "The Physics of Medical Imaging", Adam Highler, Bristol Published by CRC Press, 1988
5. Ed., Tuan Volume Dinh, “Biomedical Photonics Handbook”, CRC Press, 2003.

Reference Books:

1. John G. Webster Encyclopedia of Medical Devices and Instrumentation
2. Rangaraj M. Rangayyan, AkayMetin(Editor),Biomedical Signal Analysis: A Case Study Approach, Wiley Interscience, 2001.

3. Hykes, Heorick, Starchman, Ultrasound physics and Instrumentation MOSBY year book.
4. Zhi-Pei Laing and Paul C. Lauterbur, Principles of Magnetic Resonance imaging –A signal processing perspective, MetinAkay (Editor), IEEE press, New York, 2000.
5. Koebmer K R, "Lasers in Medicine", John Wiley & Sons.

Course Outcomes:

The student will be able to-

1. Design and test the basic Diagnostic and Therapeutic Equipment. (CO Attainment Level: 3)
2. Implement various algorithms for automatic ECG analysis. (CO Attainment Level: 4)
3. Model and detect various EEG patterns. (CO Attainment Level: 3)
4. Implement the image acquisition and reconstruction methods in radiography. (CO Attainment Level: 2)
5. Demonstrate Data acquisition and reconstruction of Doppler image. (CO Attainment Level: 3)
6. Develop applications of LASER in medical field. (CO Attainment Level: 2)

FF No. : 654

ET3014: Wireless Communication

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to Wireless Communication Systems, Examples of Wireless Communication Systems, Trends in Cellular Radio and Personal Communications.

Modern Wireless Communication Systems: Second Generation (2G) Cellular Networks, 2.5G, Third Generation (3G) wireless Networks,

The Cellular Concept: Introduction, Frequency Reuse, Channel Assignment strategies, Hand off Strategies, interference and system capacity, improving coverage and capability in Cellular Systems.

Introduction to Radio wave propagation, free space propagation model, propagation mechanisms, Practical Link Budget design using path loss models, Outdoor propagation models, Indoor propagation models, signal penetration into buildings, Ray tracing and sitespecific modeling.

Small Scale Multi path propagation, small scale multi-path measurements, parameters of mobile multi path channels, Types of small scale fading, Examples of fading behavior.

Section 2:

Performance Evaluation, Signaling Evaluation, Measurement of Average received level & level crossings, Spectrum Efficiency Evaluation, Effects & interferences caused by portable units.

Mobility Management Functions, Mobile Location Management, Mobility Model, Mobile Registration, GSM Token-Based Registration, IMSI Attach and IMSI Detach (Registration

and Deregistration) in GSM, Paging in GSM , Handoff , Handoff Techniques , Handoff Types , Handoff Process and Algorithms, Handoff Call Flows
Common Channel Signaling, Integrated Services Digital Network (ISDN), Introduction to Signaling System No.7(SS7), Global System for mobile (GSM), CDMA, Digital Cellular Standard (IS-95)

List of Practicals (Any Six):

1. Simulation of Rayleigh Fading Channel
2. Simulation of Rician Fading Channel
3. Implementation of IEEE 802.16d model.
4. Simulate Two Ray model to determine the free space loss and the power received
5. Simulate fading environment and loss based on Okumura Hata Model.
6. Simulate multipath fading channels based on COST 207 model.
7. Calculation of worst case cochannel interference ration for different constellations.
8. Simulate BER performance of DS-CDMA in multipath channel for single user case
9. simple OFDM system for transmitting audio data over frequency selective fading channel
10. Simulate multiple-input multiple-output (MIMO) multipath fading channels based on the IEEE® 802.16 channel models for fixed wireless applications.

List of Projects (Any One):

1. OFDM
2. Free Space Propagation
3. DS-CDMA
4. MIMO
5. Up & Down Conversion in Passband Communication
6. Fading

Text Books:

1. Wireless Communications- Principle and practice, Theodore S, Rappaport, Second edition, PHI
2. Mobile Communications, Jochen Schiller, Second Edition, Pearson Education.

Reference Books:

1. Heysik Kim, „Wireless Communications Systems Design“, Wiley Publications,
2. Vijay Garg, „Wireless Communications & networking“, Morgan Kaufman Series in networking.
3. Andrea Goldsmith, „Wireless Communications“, Cambridge University Press
4. William C.Y. Lee, „Wireless & Cellular Telecommunication“, McGraw Hill, 3rd Edition

Course Outcomes:

The student will be able to –

1. Differentiate four generations of wireless standard for cellular networks. (CO Attainment Level: 3)
2. Determine the type and appropriate model of wireless fading channel based on the system parameters and the property of the wireless medium. (CO Attainment Level: 3)
3. Spell the trade-offs among frequency reuse, signal-to-interference ratio, capacity, and spectral efficiency. (CO Attainment Level: 2)
4. Evaluate performance of systems. (CO Attainment Level: 1)
5. Explain mobility in wireless communication System. (CO Attainment Level: 3)
6. Describe wireless standards. (CO Attainment Level: 3)

FF No. : 654

ET3016: Sensors and Internet of Things

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to Internet of Things, Definitions and Frameworks, IoT Architecture: topologies, edge routers, client-server architecture, P2P, M2M, IoT functional blocks, Characteristics of IoT, Physical and Logical design of IoT.

Sensors: Working Principles, Selection of Sensors for Practical Applications, Introduction of Different Types of Sensors such as Displacement and position sensors, Proximity sensors, Velocity, Motion, Force and Pressure sensors, Temperature and Light sensors, etc., Signal Conditioning Devices, Equivalent circuit of Sensors and Modelling of Sensors.

Difference between smart sensor and intelligent sensor, Importance and Adoption of Smart Sensors, Architecture of Smart Sensors: Important components, their features, System design of an IoT System - Power supply, Processor, Memory Sensor Interface, Different hardware platforms for IoT.

Section 2:

IoT Communication Model, IoT networking: IPv6, 6LowPAN, CoAP, and various sensornets protocols (collision avoidance, buffering, reliability), Sensors connectivity and network layer, Gateway layer, Device - device, Device - Cloud, Device - Gateway, Gateway – Cloud.

IoT Cloud platforms, Cloud computing: web services, HTTP, RESTful interactions, service discovery, databases, API, Introduction to Fog and Mist Computing.

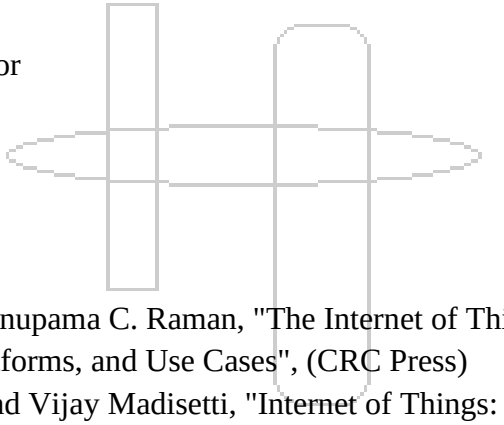
Challenges in IoT: Design challenges, Development challenges, Security challenges, Design and development of Security and Privacy Technologies related to IoT.

List of Practicals (Any Six):

1. Setting up the Raspberry Pi
2. Temperature measurement using LM35
3. Intrusion Detection using IR transmitter-receiver
4. Distance measurement using Ultrasonic sensor
5. Temperature measurement using DHT11
6. Raspberry Pi as a webserver
7. Transferring the sensor data to webpages
8. Email alert using SMTP protocol
9. Twitter alert using HTTP protocol
10. Text transfer MQTT protocol on Raspberry Pi

List of Projects (Any One):

1. Smart Home
2. Mobility and Transport
3. Energy Usage Monitoring
4. Smart Grid
5. Air Quality Monitor
6. Anti-Lost Device
7. Smart Clock
8. Smart Parking



Text Books:

1. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", (CRC Press)
2. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", (Universities Press)

Reference Books:

1. Ovidiu Vermesan& Peter Friess “Internet of Things Applications - From Research and Innovation to Market Deployment”, ISBN:987-87-93102-94-1, River Publishers
2. Joe Biron and Jonathan Follett, "Foundational Elements of an IoT Solution," by Joe Biron

Course Outcomes:

The student will be able to –

1. Demonstrate the fundamental concepts of Internet of Things. (CO Attainment Level: 3)
2. Select sensors for different IoT applications. (CO Attainment Level: 3)
3. Design IoT applications in different domains. (CO Attainment Level: 5)

4. Apply basic protocols in Wireless Sensor Networks for communication. (CO Attainment Level: 4)
5. Interface sensor data to cloud platforms. (CO Attainment Level: 4)
6. Analyze different challenges in implementing IoT applications. (CO Attainment Level: 3)

Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Technology

(*An Autonomous Institute affiliated to Savitribai Phule Pune University*)

Structure & Syllabus of

Final Year B. Tech.

(Electronics &Telecommunication Engineering)

Pattern 'D-19'

Academic Year 2019-20

Prepared by: - Board of Studies in E&TC Engineering

Approved by: - Academic Board, Vishwakarma Institute of Technology, Pune

Signed by

Chairman – BOS **Chairman – Academic Board**

Institute Vision:

To be a globally acclaimed Institute in Technical Education and Research for holistic Socio-economical development

Institute Mission:

- To ensure that 100% students are employable and employed in Industry, Higher Studies, become Entrepreneurs, Civil / Defense Services / Govt. Jobs and other areas like Sports and Theatre.
- To strengthen Academic Practices in terms of Curriculum, Pedagogy, Assessment and Faculty Competence.
- Promote Research Culture among Students and Faculty through Projects and Consultancy.
- To make students Socially Responsible Citizen.

Department Vision:

To be a center of Academic Excellence in Electronics, Telecommunication and Related Domains through Continuous Learning and Innovation.

Department Mission:

- To provide state of art education in Electronics and Telecommunication Engineering to meet current and future needs of society, industry and academia.
- To strengthen collaborations with industries and institutes of repute to foster research culture among faculty members and students.
- To promote ethically conscious engineers demonstrating sustainable entrepreneurship and professional maturity in social context.

Program Educational Objectives (PEOs):

Graduates of the program will

- Have comprehensive knowledge of Electronics engineering fundamentals to face the challenges of real life complex problems
- Be professionals imbibed with a spirit of leadership, ethical behavior and societal commitment
- Be compliant to constantly evolving technology through lifelong learning

Program Outcomes:

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and

environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge andresearch methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one‟s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Objectives (PSOs)

E&TC Graduates will have Ability to:

1. Design, Develop and Analyze Complex Electronic Systems for Communication, Signal Processing, Embedded Systems and VLSI Applications.
2. Identify and Apply domain specific hardware and software tools to solve real-world problems in Electronics and Communication.

Title: Course Structure **FF No. : 653**

Branch: E&TC **Year: Final Year** **Academic Year: 2019-20** **Semester: I/ II** **Module: NA** **Pattern: D-19**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
OE1	ET4030	Natural Language Processing	3	2	10	30	15	10	15	20	100	4
	ET4024	Mobile Communication	3	2	10	30	15	10	15	20	100	
	ET4031	Soft Computing	3	2	10	30	15	10	15	20	100	
	ET4027	Speech & Audio Processing	3	2	10	30	15	10	15	20	100	
OE2	ET4006	Advances in Digital Communication	3	2	10	30	15	10	15	20	100	4
	ET4025	Fiber Optic Communication	3	2	10	30	15	10	15	20	100	
	ET4004	SoC Design & Verification	3	2	10	30	15	10	15	20	100	
	ET4028	Wavelets	3	2	10	30	15	10	15	20	100	
OE3	ET4005	Industrial Automation	3	2	10	30	15	10	15	20	100	4
	ET4026	Adaptive Signal Processing	3	2	10	30	15	10	15	20	100	
	ET4002	RF Circuit Design	3	2	10	30	15	10	15	20	100	
	ET4017	Convergence Technologies	3	2	10	30	15	10	15	20	100	
Major Project	ET4007	Major Project 1	-	-	-	-	50	-	50	-	100	4
	ET4008	Major Project 2	-	-		-	50	-	50	-	100	4
Total												16

Abbreviations Used

ISA	In Semester Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment
GD / PPT	Group Discussion / Power Point Presentation

Title: Course Structure **FF No. : 653**

Branch: E&TC **Year: Final Year** **Academic Year: 2019-20** **Semester: I/ II** **Module: NA** **Pattern: D-19**

Sr. No.	Subject Code	Subject Name	Teaching Scheme (Hrs/Week)		Examination scheme						Total	Credits
					ISA				ESA			
			Theory	Lab	HA	LAB	MSE	GD / PPT	ESE	VIVA		
Semester Internship	ET4022	Research Internship	-	-	-	-	50	-	50	-	100	16
	ET4029	Project Internship	-	-	-	-	50	-	50	-	100	
	ET4012	Industry Internship	-	-	-	-	50	-	50	-	100	
	ET4023	International Internship	-	-	-	-	50	-	50	-	100	
Total												16

Abbreviations Used	
ISA	In Semester Assessment
HA	Home Assignment
MSE	Mid Semester Examination
ESE	End Semester Examination
ESA	End Semester Assessment
GD / PPT	Group Discussion / Power Point Presentation

FF No. : 654

ET4030: Natural Language Processing

Credits:4 **Teaching Scheme: 3 Hours / Week**
Lab/ Project: 2 Hours / Week

Section 1:
Text Processing: Basics,Empirical Laws, Spelling Correction: Edit Distance, Weighted Edit Distance, Other Variations, Noisy Channel Model for Spelling Correction, N-Gram Language Models, Evaluation of Language Models, Basic Smoothing, Language Modeling: Advance Smoothing Models, Computational Morphology, Introduction to POS Tagging, Hidden Markov Models for POS Tagging

Section2:
Viterbi Decoding for HMM, Parameter Learning, Baum Welch Algorithm, Maximum Entropy Models, Dependency Grammars and Parsing, Transition Based Parsing, MST-Based Dependency Parsing, Machine Translation, Question Answering, Conversational Agents, Speech Recognition/Speech Synthesis

List of Practicals:

1. Word analysis for morphological features
2. Apply add-one smoothing on sparse bigram table
3. To calculate bigrams and probability of a sentence for given corpus
4. To calculate emission and transition matrix for speech tagging
5. To find POS tags of words in a sentence using Viterbi decoding
6. To understand the concept of chunking and basic chunk tagset

List of Project areas:

1. Image captioning
2. Duplicate question detection
3. Reading comprehension
4. Question answering

Text Books:

1. Jurafsky& Martin "Speech and Language Processing" Prentice Hall, 2000
2. Akshar Bharati, Rajeev Sangal and Vineet Chaitanya: "Natural Language Processing: A Paninian Perspective", Prentice-Hall of India, New Delhi, 1995

Reference Books:

1. Steven Bird, Ewan Klein, and Edward Loper “Natural Language Processing with Python”, O‟Reilly Media 2009

Course Outcomes:
The student will be able to –

1. Have broad understanding of the field of natural language processing

2. Get acquainted with the algorithmic description of the main language levels: morphology, syntax, semantics, and pragmatics
3. Apply mathematical models and algorithms in applications of NLP
4. Design and implementation issues in various NLP applications such as information retrieval and information extraction
5. Relate crucial ideas in linguistics (e.g., syntax, semantics, pragmatics), artificial intelligence (e.g., knowledge representation), and machine learning (e.g., deep learning) to natural language processing.
6. Identify one of the contemporary (sub) problems of natural language processing and implement, in the form of a complete computer program as a possible solutions to it.

FF No. : 654

ET4024: Mobile Communication

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

The Cellular Concept: Introduction, Frequency Reuse, Channel Assignment strategies, Hand off Strategies, interference and system capacity, improving coverage and capability in Cellular Systems. Practical Link Budget design using path loss models, Out door propagation models, Indoor propagation models, Small Scale Multi path propagation, parameters of mobile multi path channels

Equalization & Diversity: Generic Adaptive Equalizers, Liner &nonlinear equalizers, Algorithms for equalizers, Diversity techniques, Selection diversity improvement, Maximal ratio combining improvement, Space diversity reception methods, RAKE receiver

Coding for Mobile Communication: Linear Block Codes: Syndrome and error detection, Error detection and correction capability, Galois field, Primitive element & Primitive polynomial, Minimal polynomial and generator polynomial, Description of Cyclic Codes, Generator matrix& Encoding for cyclic code, Convolutional codes – Viterbi codes, TCM, BCH codes, RS codes. Coding for fading channel

Section 2:

MIMO: MIMO, Physical Modelling of MIMO receiver, Modelling of MIMO fading channels, MIMO System model & Zero forcing receiver, MIMO MMSE Receiver, SVD, SVD based optimal MIMO transmission & capacity, V-BLAST receiver

Mobile Network & Transport Layer: TCP/IP Suite, Network Layer in the internet, TCP enhancement for wireless network, implementation of wireless network, Mobile IP & SIP

Standardized wireless Systems**:** Cognitive radio - spectrum sensing, management, sharing, GSM – overview, air interface, channels, synchronization, coding, WiMAX/IEEE 802.16 – overview, modulation, channels, Multiple Antenna Techniques. 3GPP LTE

List of Practicals (Any Six):

1. Free space Propagation – Path Loss model to determine the free space loss and the power received
2. Implementation of Cyclic Redundancy code using MATLAB/Simulink
3. Implementation of Linear block code using MATLAB/Simulink
4. Implementation of Decision feedback Equalizer
5. Performance analysis of Rake Receiver
6. Performance analysis of Maximum Ratio combiner
7. Model a fading channel based on Rayleigh Fading.
8. Model a fading channel based on Rician Fading.
9. Model a fading channel based on Rayleigh & Rician Fading.

List of Projects (Any One):

1. Multiple Input Multiple output (MIMO) application in cognitive radio
2. Performance analysis of Single user Multiple Input Multiple output (MIMO) system
3. Performance analysis of Multiple user Multiple Input Multiple output (MIMO) system
4. Performance analysis of Orthogonal Frequency division multiplexing(OFDM).
5. Performance analysis of Single user Multiple Input Multiple output (MIMO) – Orthogonal Frequency division multiplexing (OFDM) system
6. Performance analysis of Multiple user Multiple Input Multiple output (MIMO) – Orthogonal Frequency division multiplexing (OFDM) system

Text Books

1. Wireless Communications- Principle and practice, Theodore S, Rappaport, Second edition, PHI
2. Mobile Communications, Jochen Schiller, Second Edition, Pearson Education.

Reference Books

1. David Tse, PramodWishwanath, „Fundamentals of Wireless Communications", Cambridge University Press.
2. Vijay Garg, „Wireless Communications& networking", Morgan Kaufman Series in networking
3. Andreas Molisch, „Wireless Communications", Second Edition, Wiley Publications.
4. William C.Y. Lee, „Wireless & Cellular Telecommunication", McGraw Hill, 3rd Edition

Course Outcomes:

The student will be able to –

1. Determine the type and appropriate model of wireless fading channel based on the systemparameters and the property of the wireless medium. (Co Attainment level: 3)
2. Analyze different equalizers performance.(Co Attainment level: 3)
3. Spell the trade-offs among different forward error correction methods.(Co Attainment level: 3)
4. Understanding spectral efficiency & reliability gains from MIMO.(Co Attainment level: 1)
5. Differentiate between network layer of TCP/IP for mobile networking & traditional TCP/IP suite. (Co Attainment level: 2)
6. Describe different standard wireless systems. (Co Attainment level: 2)

FF No. : 654

ET4027: Speech and Audio Processing

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Anatomy and physiology of speech production. Acoustic phonetics, classification of phonemes used in American English based on continuant/non-continuant properties. Acoustic theory of speech production, sound propagation. Lossless tube model. Time-dependent speech processing. Short-time energy and average magnitude. Short-time average zero crossing rate, frequency-domain audio features, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Narrow and wide band spectrogram. Speech Vs. silence discrimination. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation. Peripheral auditory system, simplified model of cochlea. Sound pressure level and loudness. Sound intensity and Decibel sound levels. Concept of critical band and introduction to auditory system as a filter bank.

Section 2:

Basic principles of linear predictive analysis. Solution of LPC equations: Cholesky decomposition, Durbin‟s recursive solution, lattice formulations and solutions. Applications of LPC parameters as pitch detection and formant analysis. Vocoders, LPC- 10 algorithm, Real Cestrum: Long-term real cepstrum, short-term real cepstrum, pitch estimation, format estimation, Mel cepstrum. Complex cepstrum: Long-term complex cepstrum, short-term complex cepstrum. LPCC and MFCC feature extraction. Applications as complete system for speech recognition or speaker recognition

List of Practicals (Any Six):

1. To generate single tone, multi-tone stationary and non-stationary sine wave and to observe the spectrum to know the limitations of Fourier representation of non-stationary signals.
2. Record different vowels as /a/, /e/, /i/, /o/ etc. and extract the pitch as well as first three formant frequencies. Perform similar analysis for different types of unvoiced sounds and comment on the result.
3. Write a program to identify voiced, unvoiced and silence regions of the speech signal.
4. 4. Record a speech signal and perform the spectrographic analysis of the signal using wideband and narrowband spectrogram.
5. To extract pitch of the given voiced speech segment using autocorrelation and AMDF method
6. To extract the formants of speech signal using LPC and to observe the effect by changing the LPC order.

7. To implement Levinson-Durbin Algorithm for LPC parameter extraction.
8. To perform the cepstral analysis of the speech signal to extract the pitch
9. To implement limited vocabulary word recognition system.
10. To implement speaker identification system for small population (10/15 people).

List of Projects (Any One):

1. Speaker identification/verification System
2. Speech enhancement: Enhance noisy speech signal using spectral subtraction method.
3. MATLAB app development for speech signal analysis
4. Vocal Suppression
5. Low bit rate coding
6. Audio steganography
7. Speech synthesis system
8. Voice tracking system

Text Books:

1. Deller J. R. Proakis J. G. and Hanson J. H., "Discrete Time Processing of Speech Signals," Wiley Interscience
2. Thomas F. Quateri , "Discrete-Time Speech Signal Processing: Principles and Practice," Pearson

Reference Books: ***(As per IEEE format)***

1. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals," Pearson Education.
2. Ben Gold and Nelson Morgan, "Speech and audio signal processing," Wiley
3. ShailaApte, "Speech and audio processing," Wiley India Publication

Course Outcomes:

The student will be able to –

1. Demonstrate discrete time model of speech production system. (CO Attainment level: 2)
2. Detect voiced, unvoiced and silence part of a speech signal. (CO Attainment level: 3)
3. Implement algorithms for processing speech signals considering the properties of acoustic signals and human hearing. (CO Attainment level: 3)
4. Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch). (CO Attainment level: 4)
5. Extract LPC Parameters using Levinson Durbin algorithm (CO Attainment level: 4)
6. Formulate and design a system for speech recognition and speaker recognition (CO Attainment level: 5)

FF No. : 654

ET4006: Advances in Digital Communication

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction-Digital communication system , Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure. M-ary orthogonal signals,
bi-orthogonal signals, simplex signal waveforms.Receiver in additive white Gaussian noise channels-Coherent and non coherent demodulation-Matched filter, Correlator demodulator, Detector- Optimum rule for ML and MAP detection Performance- Bit error rate, symbol error rate for coherent and non coherent schemes.Synchronization-Different synchronization techniques (Early-Late Gate, MMSE, ML and spectral line methods)

Section 2:

Equalization-Zero-forcing equalizer, Decision feedback equalization, MMSE equalization.Multichannel and Multicarrier Systems-Multichannel Digital communications in AWGN channels, Multicarrier communications - Capacity of Non ideal linear filter channel, an FFT-based multicarrier system, minimizing peak to average ratio in the multicarrier systems .Communication over fading channels-Characteristics of fading channels, Rayleigh and Rician channels, receiver performance-average SNR, outage probability, amount of fading and average bit/symbol error rate.

List of Practicals (Any Six):

1. Implementation of binary communication systems.
2. Implementation of matched filter receiver in additive white Gaussian noise channel.
3. Implementation of correlator receiver in additive white Gaussian noise channel.
4. Implementation of symbol synchronizer.
5. Estimation of carrier phase using PLL.
6. Implementation of Zero-forcing equalizer .
7. Implementation of MMSE equalizer.
8. Implementation of FFT-based multicarrier system.
9. Study Rayleigh fading effect.
10. Study Rician fading effect.

List of Projects (Any One):

1. Comparison of various signaling techniques FSK ,PSK ,QAM etc on the basis of BER ,Bandwidth efficiency , peak-to-average power ratio.
2. Simulation of QAM system with decision –feedback carrier recovery.
3. Simulation of QPSK system with carrier phase recovery using costas loop.
4. OFDM simulation in MATLAB.
5. OFDM signal specrum sensing for the cognitive radio applications.

6. Performance analysis of Rayleigh and Rician fading channels.

Text Books:

1. J. G. Proakis, " Digital Communications", Fifth Edition, Mc GrawHill,

Reference Books:

1. John G. Proakis and Masoud Salehi ," Communication systems Engineering ", Second edition , PHI Learning.
2. Simon Haykin , "Digital Communications", Fourth edition , Wiley Publications.
3. B. Sklar, "Digital Communication", Second edition , Pearson.

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Course Outcomes:

The students will be able to

1. Represent signals using the Gram-Schmidt orthogonalization procedure (CO Attainment level : 4)
2. Design and study performance characteristics of optimum receiver (CO Attainment level : 1)
   for the various modulating methods. (CO Attainment level : 3)
3. Derive carrier and symbol synchronization. (CO Attainment level : 3)
4. Analyze performance characteristics of equalizer algorithms. (CO Attainment level : 3)
5. Analyze performance of multichannel and multicarrier systems. (CO Attainment level : 3)
6. Evaluate performance of digital signaling techniques for communication over fading multipath channels. (CO Attainment level : 3)

FF No. : 654

ET4025: Fiber Optic Communication

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to fiber optic communication

Overview of optical fiber communication: Fiber optic communication system, Advantages of optical fiber communication, Ray theory transmission, total internal reflection. Parameters of fiber optic cable: Acceptance angles, Numerical aperture, skew rays, Mode, Index Profile, V number. Types of fiber optic cable. Material of fiber optic cable, Manufacturing process of fiber optic cable.

Signal degradation in fiber optic cable

Signal distortion in optical fibers : Attenuation ,Material absorption ,Scattering losses (linear) Bending losses ,Dispersion present in FOC, Fiber attenuation measurement , Optical Time Domain reflectometer (Principle, concept & applications).

Nonlinear scattering losses , Fiber dispersion measurement.

Optical sources , detectors and sensors

Light emitting diode: LED power and efficiency, LED structures, LED characteristics, Modulation. Light amplification by stimulated emission of Radiation : Basic concepts of LASER, Injection LASER structures. Optical detectors: Optical detection principles, Characteristics of optical detector, photodiode, PIN diode, Avalanche photodiode. Optical sensors : Phase and polarization fiber sensors, Intrinsic fiber sensors, Extrinsic fiber sensors, Optical Connectors & splices to connect Fiber optic cables.

Section 2:

Fiber optic system

Optical transmitter circuit, Optical receiver circuit, Link power budget, Rise time budget , Analog system design. Digital system design.

Real world applications of fiber optics : Study of fiber optics such as in i) Underwater communication ii) Telephone system iii) Military applications.

Optical Networks: SONET/ SDH , Wavelength Division multiplexing

List of Practicals (Any Six):

1. To measure numerical aperture
2. To measure attenuation and bending losses for various lengths of fiber optic cables
3. Experiment for transmission of analog signal through fiber optic cable
4. Experiment for transmission of digital signal through fiber optics cable
5. Experiment to plot V-I Characteristic of optical source
6. Experiment to measure frequency response of optical receiver
7. Experiment to transmit voice through fiber optic cable

8. Experiment to transmit frequency modulated signal through fiber optic cable
9. Study of Optical Fiber Connectorization Kit

List of Projects (Any One):

1. Implementation of optical transmitter
2. Implementation of optical receiver
3. Implementation of fiber optic system
4. Underwater communication through fiber optic cable
5. Telephone system using fiber optic cable

Text Books

1. "Optical Fiber Communications", Gerd Keiser , McGraw Hill 2. John M. Senior,
2. "Microwave and Radar engineering" M. Kulkarni, Umesh Publication

Reference Books

1. "Fiber Optic Communications" ,D.K. Mynbaev , S.C. Gupta and Lowell L. Scheiner,Pearson Education, 2005.
2. " Fiber Optic Communication Systems", Govind P. Agarwal , John Wiley,3rd Edition,2004.

Course Outcomes:

The student will be able to –

1. Explain the key aspects of propagation through different types of fiber. (CO Attainment level : 3)
2. Analyze losses of signals.(CO Attainment level : 3)
3. Describe fiber optic communication system. (CO Attainment level : 3)
4. Prepare the budget for implementing the fiber optic communication system. (CO Attainment level : 3)
5. Relate type of fiber optic communication to a specific application. (CO Attainment level : 2)
6. Explain different real world applications of fiber optics.(CO Attainment level : 2)

FF No. : 654

ET4004: SoC Design and Verification

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to the System Approach:

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Memory Design for SOC: Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation, SOC Memory System, Models of Simple Processor – memory interaction.

Section 2:

Interconnect Customization and Configuration: Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time.

SOC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance- Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism.

Application Studies / Case Studies: SOC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

List of Experiments & Projects:

Text Books:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt. Ltd.

Reference Books: ***(As per IEEE format)***

1. ARM System on Chip Architecture – Steve Furber –2 nd Ed., 2000, Addison Wesley Professional.

Course Outcomes:

The student will be able to –

1. Understand basic concept of System Design and Interconnections. (CO Attainment level : 4)
2. Implement instruction for various Processor Architecture. (CO Attainment level : 4)
3. Design Memory for SOC. (CO Attainment level : 4)
4. Solve issues related to interconnection and Bus models. (CO Attainment level : 3)
5. Analyze concepts related to SOC customization. (CO Attainment level : 3)
6. Design algorithms. (CO Attainment level : 5)

FF No. : 654

ET4028: Wavelets

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to wavelet transform, comparison with DFT and DCT. Introduction to time frequency analysis, Definition of CWT, properties of continuous wavelet transform, CWT as correlation, CWT as an operator, Inverse CWT. Approximation of Vectors in linear vector subspaces, Basis for approximating sub spaces and Haar Scaling function, Digital filter implementation of Haar Wavelet Decomposition. Definition of MRA, Construction of general orthonormal MRA,Wavelet Basis for MRA, Digital Filtering Intepretation, Examples of Orthogonal Basis-generating Wavelets, Interpreting orthonormal MRAs for Discrete time Signal.

Section 2:

Introduction to time frequency analysis Different families of wavelets, mathematical preliminaries, windowed Fourier transform, short-time Fourier transform, Haar wavelet, Daubechies Wavelets, Wavelet packet analysis, Haar wavelet packets, introduction to orthogonal and bi-orthogonal wavelets. Transform Coding, Image compression using DTWT, Audio Compression, and Video Coding using MRA. Application of wavelet theory to signal de-noising, transient detection, speckle removal, edge detection and object isolation, image fusion, image enhancement, feature extraction, communication applications like scaling functions as signaling pulses and multi-tone modulation.

List of Practicals (Any Six):

1. To study various wavelets families.
2. To study Haar wavelets filter banks.
3. To study the Continuous Wavelet Transform: composition and decomposition.
4. To study the Discrete Wavelet Transform: composition and decomposition.
5. To write and verify code for signal/image smoothing using wavelet transform.
6. To write and verify code for signal/image de-noise using wavelet transform.
7. To write and verify code for signal/image compression using wavelet transforms.
8. To write and verify code for signal/image edge detection using wavelet transforms.
9. To write and verify code for signal/image matching using wavelet transforms.
10. To write and verify code for signal/image fusion using wavelet transforms.

List of Projects (Any One):

1. Data(Image, audio/video) compression
2. Speech processing
3. Noise/trend reduction
4. Texture analysis

5. Pattern recognition
6. Image processing

Text Books:

1. Raghuveer Rao , AjitBopardikar , “Wavelet Transforms: Introduction to Theory and Applications”, Pearson Education.
2. K P Soman, K I Ramchandran , "Insight Into Wavelets - From Theory to Practice", PHI publication (2nd edition), Prentice Hall of India.

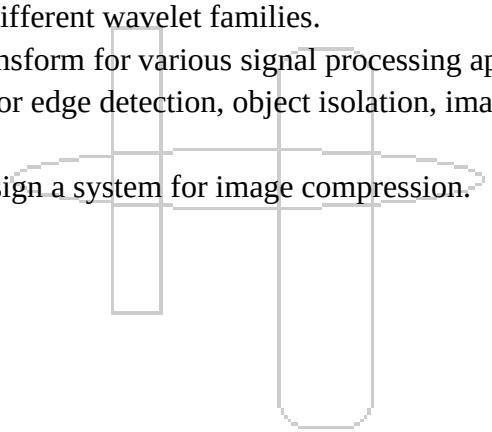
Reference Books:

1. Wavelet Analysis –by Springer Publication.
2. Ten lectures on wavelets –by Daubechies I (CBMS-NSF, SIAM, 1982).
3. “Multirate Systems and Filter Banks”, P. P. Vaidyanathan, Pearson Education.

Course Outcomes:

The student will be able to –

1. Understand fundamentals of continuous and discrete wavelet transform.
2. Interpret multi resolution analysis.
3. Familiarize with different wavelet families.
4. Apply wavelet transform for various signal processing applications.
5. Write a program for edge detection, object isolation, image fusion, image enhancement.
6. Formulate and design a system for image compression.



FF No. : 654

ET4005: Industrial Automation

Credits: 4 **Teaching Scheme: 5 Hours / Week**

Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Introduction to Industrial Automation and Control, Architecture of Industrial Automation Systems, types, pyramid of automation, advantages and disadvantages, Measurement systems – static and dynamic , Measurement of Temperature, Pressure and Force, Measurement of Displacement and Speed, Introduction to Process Control, P-I-D Control, Implementation of P-I-D Controllers, PLC Hardware Environment, Software Environment and Programming of PLCs, Ladder Programming

Section 2:

Hydraulic and Pneumatic control Systems - Principles and Components, Actuators- Hydraulic, pneumatic and electrical, DC motor, Servo motor, stepper motor and drives, Fuzzy logic in control applications- concepts, membership functions, fuzzy inference, Fuzzy controller in automation, Case studies of Industrial automation systems

List of Practicals (Any Six):

1. Simulate analog and digital function blocks for DCS
2. Study hardware and software used in PLC
3. Implementation Logic Gates
4. Implementation of On-Delay Timer
5. Implementation of Up-Down Counter
6. Implementation of PLC Arithmatic Instructions
7. Logic implementation for traffic Control Application
8. Logic implementation for Bottle Filling Application
9. Temperature measurement
10. Speed measurement using encoder

List of Projects (Any One):

1. Design of PID Controller
2. Design of Fuzzy Controller

Text Books:

1. Mechatronics, W. Bolton, 4th Ed, Pearson
2. A course in Electrical and Electronic Measurements and Instrumentation, A.K. Sawhney, Dhanpat Rai and Co.

Reference Books:

1. Industrial instrumentation, control and automation, S. Mukhopadhyay, S. Sen& A. K. Deb, Jaico Publishing House

Course Outcomes:

The student will be able to –

1. Describe Architecture of Industrial Automation Systems (CO Attainment level:2)
2. Explain Measurement systems (CO Attainment level: 3)
3. Demonstrate ladder programming skills (CO Attainment level:4)
4. Compare Hydraulic/ Pneumatic control Systems (CO Attainment level: 3)
5. Compare Actuators (CO Attainment level: 3)
6. Design fuzzy controller (CO Attainment level: 4)

FF No. : 654

ET4026: Adaptive Signal Processing

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Stochastic Processes:ensemble averages, jointly distributed random variables, joint moments, independent, uncorrelated and orthogonal random variables, linear mean square estimation. Random processes: ensemble averages, stationary processes, autocorrelation and auto-covariance matrices, ergodicity.

Signal Modeling:Least square method, Pade approximation, Prony‟s method. Finite data records: autocorrelation and covariance method, Stochastic Models: Autoregressive moving average models, autoregressive models, moving average models.

Linear Prediction: Forward linear prediction, backward linear prediction, Levinson-Durbin algorithm, lattice filter, predictive modeling of speech

Section2:

Wiener Filters: Minimum mean square error (MMSE) and orthogonality principle, digital Wiener filter and Wiener-Hopf equations. Applications: filtering, noise cancellation, linear prediction.

Adaptive filtering:FIR adaptive filters: the steepest descent adaptive filter, Lease-Mean-Square (LMS) adaptive filters, convergence of LMS algorithm, normalized LMS. Applications: noise cancellation, channel equalization, adaptive recursive filters.

Spectrum Estimation: Nonparametric methods: Periodogram, modified periodogram, Bartlett‟s method, Welch‟s method. Parametric methods: autoregressive spectrum estimation, moving average spectrum estimation, autoregressive moving average spectrum estimation

List of Practicals (Any Six):

1. Computing the probability density function of a Gaussian random sequence with specified mean and variance
2. Simulation of Autoregressive moving average model.
3. Implementation of Lattice Structure
4. Program to convert Direct form coefficient to Lattice Form
5. Program to convert Lattice form coefficient to Direct Form
6. Implementation of Levinson Durbin Algorithm
7. Deconvolution using Wiener Filter.
8. Simulation of Linear predictive model
9. Simulation of LMS algorithm for adaptive noise cancellation
10. Power Spectrum Estimation

List of Projects (Any One):

1. Spectrum estimation using autoregressive modeling

2. Echo cancellation in telephone circuits
3. Adaptive prediction for speech coding
4. System identification and inverse filtering
5. Active noise cancellation
6. Channel Equalization

Text Books:

1. Simon Haykin, "Adaptive Filter Theory", 4th edition, Pearson Education
2. Monson Hayes, "Statistical Digital Signal Processing and Modeling", Wiley India Edition

Reference Books:

1. Dimitris G. Manolakis, Vinay K. Ingle, Stephen M. Kogon, "Statistical and Adaptive Signal Processing: Spectral Estimation, Signal Modeling, Adaptive Filtering and Array Processing", McGrawHill, 2000
2. Bernard Widrow and Samuel Stearns, "Adaptive Signal Processing", Pearson Education Asia,2002

Course Outcomes:

The student will be able to –

1. Apply basic probability theory to model random signals in terms of Random Processes. (CO Attainment level: 4)
2. Find a model to provide an accurate estimation of the signal. (CO Attainment level: 5)
3. Represent speech signal using linear predictive coding (LPC) algorithm. (CO Attainment level: 4)
4. Formulate the Wiener filter as a constrained optimization problem. (CO Attainment level: 4)
5. Determine suitable LMS step size to trade off convergence time and mis-adjustment. (CO Attainment level: 4)
6. Derive the power spectrum of random signals. (CO Attainment level: 4)

FF No. : 654

ET4002: RF Circuit Design

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OCτs, Considerations, Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Accuracy of SCτs, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation Between Rise Time and Bandwidth.

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni-lateralization. Characteristics of RF amplifier. Amplifier power relations. Bandwidth estimation using short circuit, Bandwidth group delay & peaking

Section 2:

MOSFET two port noise parameters, LNA topologies, Motivation First Cut Design, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator.

Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer

Receivers: architectures – direct conversion, Heterodyne, Image reject receiver, VCOs, VCO design, Phase Noise – LTI & LTV analysis, Analog RF layout

List of Practicals (Any Six):

1. To plot frequency response of the impedance magnitude of series and parallel LC circuits.
2. To plot the resonant frequency behavior of parallel LC circuit, as a function of resistance R.
3. To determine stability regions of the device and sketch them in the Smith Chart. Assume suitable parameters.
4. To design, prepare layout and simulate CMOS amplifier for given voltage gain and bandwidth.

5. To design, prepare layout and simulate CMOS Collpitt oscillator.
6. To design, prepare layout and simulate CMOS mixer.
7. To design, prepare layout and simulate CMOS LNA.
8. To design, prepare layout and simulate double balance mixer.
9. To design, prepare layout and simulate diode Ring mixer.
10. To design, prepare layout and simulate local oscillator.

List of Projects (Any One):

1. RF Amplifier
2. Oscillators
3. Mixers
4. LNA
5. Mixers
6. MOSFET

Text Books:

1. Reinhold Ludwig, PavelBretchko, "RF Circuit Design Theory and Applications", Pearson Education.
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Second Edition, Cambridge Publications.

Reference Books:

1. T. Yettrdal, Yunhg Cheng, "Devices modeling for analog and RF COMS circuits design", John Wiley publication.
2. Calvin Plett, "Radio frequency Integrated Circuits Design", Artech house.

Course Outcomes:

The student will be able to –

1. Understand behavior of passive components at high frequency and modeling of HF circuit. (CO Attainment level : 3)
2. Estimate bandwidth of RF system. (CO Attainment level : 3)
3. Design HF amplifiers with gain bandwidth parameters. (CO Attainment level : 2)
4. Model low noise amplifier. (CO Attainment level : 2)
5. Simulate & model oscillators. (CO Attainment level : 2)
6. Understand Mixer types and characteristics. (CO Attainment level : 3)

FF No. : 654

ET4017: Convergence Technology

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Section 1:

Analog telephony - Basic Circuits(loopstart, Groundstart), Lines and Trunks, DTMF, CP Tones, Supervisions, Disadvantages of Analog telephony, Basic Call Fence post diagram.
Digital Telephony - Advantages, Signalling Mode(CAS, CCS)
Digital Telephony: T1/E1 Circuits, Clock Synchronization, Line coding, Framing formats, Standards and Standardization bodies, Basic ISDN Protocol Stack, ISDN Reference points, Bearer and D-Channel. Digital Telephony: Q.931 Protocol, Basic ISDN Signalling fence Post diagram, Nodal Messages, Timers, Information Elements, Code Points, Code Sets Supplementary Services, Integrated Voice, Video and Data, Cost of basic and supplementary services, Requirements of an Enterprise - Integation of e-mail, chat, mobility, user identity, video/content sharing, Motivation for VoIP, Integration of Voice and Data networks.
Packet switching, Connection oriented and connectionless services, Delay/Quality of service in packet switched networks, Role of RTP, Audio Codecs - Sampling rate, Packetization, Compression
Video Codecs, Signalling and Media. H.323 Protocol Stack introduction, H.323 Network Elements and Significance, Endpoint Registration using RAS.H.225 Protocol, Call Flows for audio Calls,H.245 Protocol, Call Flows for audio/Video calls, Introduction to SIP, SIP Network Elements, SIP Protocol: Requests & Responses, Methods, Mandatory Headers & Parameters, Message Structure, Dialogs and Transactions Session Description Protocol, Audio/Video Call Flows,H.248 Protocol: Media Gateways, Media Gateway Controllers, Commands, Transactions, Contexts, Terminations, Descriptors, Packages
Buffer.

Session 2:

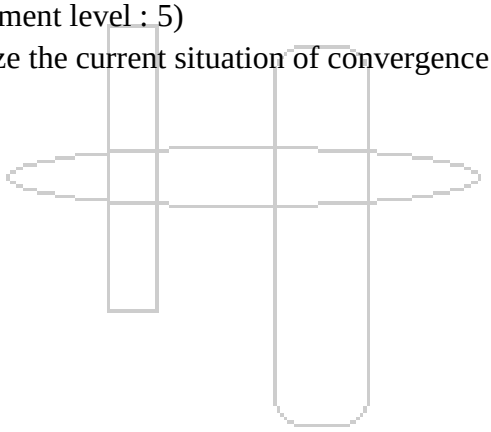
Business Use cases: Enterprise and Service providers (AKA Carriers), Typical enterprise Topology, Types of enterprises and business needs. Basic features: Hold, Transfer, Conference, Forward, Coverage/Voicemail, Bridging, Mobility, Collaboration: Integration of Voice, Video, Content and enterprise communication channels such as email, IM, web applications. Use cases and call flows.
Introduction to Contact Center, Contact Center types, Contact Center Terminologies, Contact Center Infrastructure and Technology, Activity/Quiz – I, Contact Center Use Cases and applications,
Q&A, Activity/Quiz – II, Voice application protocols - VXML, CCXML, MRCP, Outbound Contact Center Application flows - voice, SMS, email, custom solutions; Activity/Quiz – III,CTI Application protocols - CSTA, TSAPI, JTAPI, Inbound Contact Center Application flows - voice, email, chat, social media, custom solutions; Activity – IV, Contact Center Reporting, Recording, WFM, WFO,Q&A, Activity/ Quiz –II, Cloud Computing: UCaaS, CCaaS, Client SDKs and integration of VoIP with phone apps. Use cases such as Bank

applications, Retail online shops. Components for VoIP enablement supported in Android, Components for VoIP enablement supported in IOS, WebRTC, Analytics in Voice & Data, Buffer.

Course Outcomes:

The student will be able to –

1. Understand the making of a network from heterogeneous multi-sources. (CO Attainment level : 2)
2. Analyze the convergence between the technology providers and the other business personnel about the firm's business activities and the importance of the technology in supporting those activities.(CO Attainment level : 3)
3. Implement the convergence of Voice, Video, image, and data over Internet Protocol over wired and wireless networks that provide seamless and secure communication solutions for business, government, and home technology needs.(CO Attainment level : 4)
4. Analyze and Implement the Interoperability, the integrating of disparate systems.(CO Attainment level : 3)
5. To construct a weighted network by gathering data from three different sources and meta-data matching.(CO Attainment level : 5)
6. Understand and Analyze the current situation of convergence technology R&D.(CO Attainment level : 5)



FF No. : 654

ET4007: Major Project 1

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Major project course is effective in preparing students for their project work. It emphasizes on learning by doing for a complete project life cycle, requirement analysis, realistic planning and transforming ideas into product.

Major-Project Guidelines:

1. The Major-project is a team activity having 3-4 students in a team. This is electronic product design work.
2. The Major-project may be a complete hardware or a combination of hardware and software work. The software part in Major-project should be less than 50% of the total work.
3. After interactions with course instructor and based on comprehensive literature survey / requirement analysis, the student shall identify the title and define objectives of the Major-project.
4. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
5. The student is expected to meet the timelines on design, development and testing of the proposed work.
6. The student is instructed to have discussion with faculty instructor on standard practices used for electronic circuit / product design, converting the circuit design into a complete electronic product, PCD design using suitable simulation software, estimation of power budget analysis of the product, front panel / user interface design and mechanical aspects of the product.
7. Completed Major-project and documentation in the form of Major-project report is to be submitted at the end of the semester. The project group will deliver the presentation of the Project Work which will be assessed by the panel.

Course Outcomes:

The graduates will be able to -

1. Identify Real World Problems, develop realistic expectations, set achievable goals.
2. Design, implement and test the prototype / algorithm, interpret the results to solve conceived problem.
3. Develop organizational skills as decision making, planning, preparations and record keeping.
4. Develop team working skills, communication, organization and leadership.

Note:

The student needs to identify a technological problem in the following sectors:

1. Social relevance (Agriculture/ Water Management / Transportation / Waste Management / etc.)
2. Renewable Energy (Solar / Wind / Waves / etc.)
3. Green Technology (Carbon footprint / Pollution control / etc)
4. Assistive System for Weaker People (Blind / Deaf / Handicap assistive)
5. Security Enhancement (Cyber Security / Forensics)
6. Government Projects (Smart City / Smart Grid / Smart Gram / Swach Bharat / etc.)

FF No. : 654

ET4008: Major Project 2

Credits: 4

Teaching Scheme: 5 Hours / Week
Theory: 3 Hours / Week
Lab/ Project: 2 Hours / Week

Major project course is effective in preparing students for their project work. It emphasizes on learning by doing for a complete project life cycle, requirement analysis, realistic planning and transforming ideas into product.

Major-Project Guidelines:

1. The Major-project is a team activity having 3-4 students in a team. This is electronic product design work.
2. The Major-project may be a complete hardware or a combination of hardware and software work. The software part in Major-project should be less than 50% of the total work.
3. After interactions with course instructor and based on comprehensive literature survey / requirement analysis, the student shall identify the title and define objectives of the Major-project.
4. Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and submit the proposal within first week of the semester.
5. The student is expected to meet the timelines on design, development and testing of the proposed work.
6. The student is instructed to have discussion with faculty instructor on standard practices used for electronic circuit / product design, converting the circuit design into a complete electronic product, PCD design using suitable simulation software, estimation of power budget analysis of the product, front panel / user interface design and mechanical aspects of the product.
7. Completed Major-project and documentation in the form of Major-project report is to be submitted at the end of the semester. The project group will deliver the presentation of the Project Work which will be assessed by the panel.

Course Outcomes:

The graduates will be able to -

1. Identify Real World Problems, develop realistic expectations, set achievable goals.
2. Design, implement and test the prototype / algorithm, interpret the results to solve conceived problem.
3. Develop organizational skills as decision making, planning, preparations and record keeping.
4. Develop team working skills, communication, organization and leadership.

Note:

The student needs to identify a technological problem in the following sectors:

1. Social relevance (Agriculture/ Water Management / Transportation / Waste Management / etc.)
2. Renewable Energy (Solar / Wind / Waves / etc.)
3. Green Technology (Carbon footprint / Pollution control / etc)
4. Assistive System for Weaker People (Blind / Deaf / Handicap assistive)
5. Security Enhancement (Cyber Security / Forensics)
6. Government Projects (Smart City / Smart Grid / Smart Gram / Swach Bharat / etc.)

FF No. : 654

ET4012: Industry Internship
ET4022: Research Internship
ET4029: Project Internship
ET4023: International Internship

Credits: 16

Industry/ Research/ Global Internship is an educational innovation seeking to link industry experience with university instruction. Internship enables students to acquire learning by applying the knowledge and skills they possess in open-ended real-life situations of a rapidly changing needs and challenges in a professional workplace. Internship provides the required platform for experiential and cooperative learning and education, by providing students with an opportunity to work on industry assignments, under the guidance of professional experts and under the supervision of faculty. Students are offered 18 weeks industry internship to enhance their skillset and get exposure of industry front. Internship facilitates and promotes partnership and intellectual exchange between academia and industry.

Course Outcomes:

Upon successful completion of Industry Internship, student will be able to

1. Acquire practical knowledge within the chosen area of technology for project development.
2. Identify, analyze, formulate and develop projects with a comprehensive and systematic approach.
3. Cooperate with diverse teams and effectively communicate with all the stake holders.
4. Produce solutions within the technological guidelines and standards.
5. Develop effective communication skills for presentation of project related activities.