SEMESTER-I

BASIC ELECTRONICS ENGINEERING		Course Code: EC101	Credits: 4
No. of Lectures (Hrs/Week): 4	No. of Lectures (Sem.): 60	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: Passive Components

Resistances, Capacitors and Inductors, Component Specifications, Applications, Response to dc and sinusoidal voltage/current excitations. **Semiconductor Theory:** Metals, Insulators and Semiconductor materials, energy band diagram, Intrinsic and Extrinsic Semiconductors, Doping, Fermi level, Fermi level of P-type and N-type materials, Mobility, Drift Current and Diffusion Current. Current conduction in Semiconductors, Generation and Recombination of Charges

Unit II: Semiconductor Diodes

Theory of P-N Junction, Ideal & Practical diode, Concept of AC and DC Resistances, V-I Characteristics, Diode Equivalent Circuits, Transition and Diffusion Capacitance, Reverse Recovery Time, Zener and Avalanche breakdown, Tunnel Diodes, Varactor Diode, Light Emitting Diode

Unit III: Diode Applications and Wave Shaping Circuits

Load line analysis, series and parallel combinations, Half wave & Full wave Rectifiers, Clippers & Clampers.

Unit IV: Transistors

Bipolar Junction Transistor- Construction, Operation, Transistor Configurations, Input and Output Characteristics, AC and DC Load line, operating point, Effect of shifting the operating point. Biasing, Thermal Runaway, Effect of temperature on the characteristics, Early effect, introduction to JFET and MOSFET

Unit V: Logic Gates and Operational Amplifiers

Binary number, Digital systems, Boolean algebra, logic gates, logic functions, realization of logic gates by electronic devices, Positive and negative logic, representation of binary numbers, half adder, full adder, flip-flops, Op-Amp, Practical Op-Amp, Open loop and closed loop configurations, Applications of Op-Amps as inverting and non-inverting amplifier

Text Books:

[1] Boyelasted an Nashlsky, Electronics Devices and Circuit Theory, TMH.
[2] Gayakwad, Op-Amps and Linear Integrated Circuits, PHI.

Reference Books:

[3] Millman & Halkias, Integrated Electronics, TMH.
[4] Morris Mano, Digital Design, PHI.
[5] Malvino, Electronics Principles, TMH.

I-YEAR (I-SEMESTER)

BASIC ELECTRONICS ENGINEERING LAB		**Course Code:** EC181	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. Study of Multimeter and Function Generator /Counter.
2. Study of Cathode-Ray Oscilloscope.
3. To calculate the Equivalent Resistance of the Series and parallel resistive network.
4. To calculate the Equivalent Capacitance of the Series and parallel capacitive network.
5. To Plot the V-I Characteristics of P-N Junction Diode in forward bias and reverse bias.
6. To study the working of a P-N Junction Diode as a switch.
7. To plot the V-I Characteristics of a Zener Diode.
8. To plot the input and output waveforms of clipper circuits.
9. Study the Half wave rectifier.
10. Study of Full wave Bridge Rectifier.
11. Study of Centre Tapped Full Wave Rectifier.
12. To plot the input and output characteristic of transistor’s Common Base configuration.
13. To plot the input and output characteristic of transistor’s Common Emitter configuration.
14. To plot the input and output characteristic of transistor’s Common Collector configuration.
15. To verify the truth table of various logic gates.

SEMESTER- III

II-YEAR (III-SEMESTER)

FUNDAMENTAL OF DIGITAL ELECTRONICS		**Course Code:** EC221	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Minimization of Logic Function
Review of logic gate and Boolean algebra, Standard representation of logical functions, K-map representation and simplification of logical functions using Boolean algebra and K-map method, Quine - McClusky's method, Don't care conditions.

Unit II: Combinational Circuits
Combinational circuit design, adders, subtractor, code converters, magnitude comparators, decoders, encoders, multiplexers, de-multiplexer, parity checker.

Unit III: Sequential Circuits, Shift Registers and Counters
Sequential Circuits: R-S, J-K, D, T Flip-flops, race around condition, Master–Slave flip-flops, Edge triggered Flip Flop, Excitation table of a flip-flop, Analysis and design procedure to a synchronous sequential circuit, Conversion of flip flops from one to another.
Shift Registers: Buffer register, shift operations, SISO, SIPO, PISO, PIPO, and universal shift registers and applications**.**
Counters: Ripple counter, Decade counter, Design of Synchronous counters, Programmable, down, Up, mod-m counters, difference between synchronous and asynchronous counters, ring, Johnson, cascade counters and application.

Unit IV: Logic Families
Diode and transistor as a switch, type and specification of digital logic family, RTL, DCTL, DTL, ECL, TTL and its various types, MOS, CMOS, BiCMOS logic families, Characteristics and comparison of logic families.

Unit V: Semiconductor Memories and D/A and A/D Converters
Semiconductor Memories: Memory organization, Classification and characteristics of memories, sequential memories, RAM – static and dynamic, ROM, PROM, EPROM, EEPROM and Programmable logic arrays.
D/A and A/D Converters : Weighted register D/A converter, binary ladder D/A converter, steady state accuracy test, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter Successive approximation A/D converter, Single and dual slope A/D converter A/D accuracy and resolution.

Text Books:

[1] Malvino, Digital Principle and Applications, TMH
[2] R. P. Jain, Modern Digital Electronics, PHI

Reference Books:

[3] Malvino, Digital electronics principle, THM
[4] R J Tocci, Digital Electronics, PHI
[5] Dr A K Gautam, Digital Electronics, Khanna Publication

II-YEAR (III-SEMESTER)

NETWORK ANALYSIS		**Course Code:** EC223	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Circuit Concepts and AC Network Theorem
Circuit Concepts: Independent and dependent sources, signals and wave forms; periodic and singularity voltages, step, ramp, impulse, Doublet. Loop currents and loop equations, node voltage and node equations
AC Network Theorem: Super-position theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Compensation teorem, Tellegen's theorem.

Unit II: Graph Theory
Graph of a network, definitions, tree, co-tree, link, basic loop and basic cut set, incidence matrix, cut set matrix, Tie set matrix duality, Loop and Node methods of analysis.

Unit III: Two Port Network
Characterization of LTI two port networks, Z, Y, ABCD and h-parameters, reciprocity and symmetry. Interrelationships between the parameters, inter-connections of two port networks, Ladder and Lattice networks. T and π representation.

Unit IV: Network Synthesis
Network functions, Impedance & Admittance function, Transfer functions, Relationship between transfer and impulse response, poles and zeros and restrictions, Network function for two terminal pair network, Sinusoidal network in terms of poles & zeros, Real liability condition for impedance synthesis of RL & RC circuits, Network synthesis techniques for 2-terminal network, Foster and Cauer forms.

Unit V: Filter Synthesis
Classification of filters, characteristics impedance and propagation constant of pure reactive network, Ladder network, T section, π –section, terminating half section, Pass bands and stop bands, Design of constant-K, m-derived filters, Composite filters.

Text Books:

[1] D R Choudhury, Network & Systems, New Age International.
[2] Van Valkenberg, Network Analysis & Synthesis, PHI International.

Reference Books:

[3] Sudhakar Sham Mohan , Network Analysis and Synthesis, TMH
[4] IVS Iyer , Network Synthesis, TMH
[5] Joseph A. Edminister, Electric Circuits, TMH
[6] A. Chakraborty, Circuit Theory: Analysis and Synthesis, Dhanpat Rai Publisher.

INTRODUCTION TO SIGNAL AND SYSTEMS		**Course Code:** EC225	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Signals and Systems
Continuous-time and discrete-time signals, transformations of the independent variable, Exponential and Sinusoidal signals, Continuous-Time and discrete-Time LTI Systems and their properties, convolution sum and convolution integrals, LTI System described by differential and difference equation.

Unit II: Fourier Series and Fourier Transform
The response of LTI systems to complex exponentials, Fourier series representation of continuous-time, periodic signals and their properties, continuous time and discrete time Fourier transforms and their properties, system, characterized by linear constant coefficient differential equations and difference equation.

Unit III: Time and Frequency Characterization of Signals and Systems
Magnitude phase representation of the Fourier transform, magnitude phase representation of the frequency response of LTI systems, time domain properties of ideal frequency selective filter, time domain and frequency domain aspects of non-ideal filters, first order and second order continuous time and discrete time systems.

Unit IV: Laplace Transformation
Laplace transform, region of convergence, inverse Laplace transform, analysis and characterization of LTI system, block diagram representation, unilateral Laplace transform.

Unit V: Sampling and Z-Transform
Signal representation by samples, sampling theorem, impulse train sampling, sampling of discrete time signals, discrete time processing of continuous time signals., Z-Transform, Region of convergence, Inverse Z-transform, analysis and characterization of LTI system, block diagram representation, Unilateral Z-transform.

Text Books:
[1] Oppenheim, Willsky & Young, Signal and Systems, John Wiley & Sons.
[2] Michael J. Roberts, Fundamental of Signals and Systems, McGraw Hill.

Reference Books:
[3] Simon Haykin, Communication Signal and Systems, John Wiley & Sons.

ANALOG ELECTRONIC CIRCUITS		**Course Code:** EC227	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Transistor Models and Multistage and Tuned Amplifier
Transistor: Review of BJT biasing circuits, biasing stabilization techniques, Thermal runaway, thermal stability, Transistor Hybrid Model, Conversion of h-parameters in transistor three configurations.
Multistage and Tuned Amplifier: Cascade amplifiers, coupling of amplifiers, RC coupled, direct coupled, and transformer coupled amplifiers, differential amplifier, Darlington amplifier, bootstrapping, tuned and double tuned amplifiers.
High Frequency Amplifiers
Hybrid $\pi -$ model, conductances and capacitances of hybrid $\pi -$model, high frequency analysis of CE amplifier, gain-bandwidth product, Emitter follower at high frequencies,

Unit II: JFET and MOSFET
JFET: Structure, operating principle, amplifier, biasing analysis, small signal model of JFET, MOSFET-enhancement and depletion type, I-V characteristics, MOSFET amplifiers, MOSFET Resistor, MOS Capacitor, Power MOSFETs, High frequency analysis of common source, common gate and drain amplifiers. Complementary MOSFET.

Unit III: Feedback Amplifiers
Classification, Feedback concept, Transfer gain with feedback, General characteristics of negative feedback amplifiers, Analysis of voltage-series voltage-shunt, current-series and current-shunt feedback amplifiers, Stability criterion.

Unit IV: Oscillators
Classification, Criterion for oscillations, Hartley, Colpitts, Clapp, RC Phase shift, Wien Bridge and crystal oscillators, astable, monostable and bistable multivibrators using transistors.

Unit V: Power Amplifiers
Power amplifier circuits, Class A, class B and class AB and, class C amplifiers, push pull amplifiers with and without transformers, Complementary symmetry amplifiers, Distortion, thermal consideration and power dissipation of power amplifiers.

Text Books:
[1] Millman & Parekh, Integrated Electronics, TMH
[2] Salivahanan, Electronic Devices and Circuits, TMH.
[3] Jaeger & Blalock, Microelectronic Circuit Design, McGraw Hill.

Reference Books:
[4] Millman & Halkias, Electronic Devices And Circuits,TMH
[5] Gray, Analysis And Design of An Analog Integrated Circuit, Wiley.
[6] Boylested, Electronic Devices And Circuit Theory, Pearson
[7] Floyd, Electronic Devices, Pearson
[8] Singh, Electronic Devices And Integrated Circuits, Pearson.
[9] Behzad Razavi, Fundamentals of Microelectronics, John Wiley.
[10] David A. Bell Electronic Devices And Circuits, Oxford
[11] Sedra & Smith, Microelectronic Circuits, Oxford

ANALOG ELECTRONIC CIRCUITS LAB		**Course Code:** EC271	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. To verify the configuration of various biasing techniques for BJTs.

2. To determine voltage gain output impedance and output power of a Darlington pair compound amplifier.

3. To determine “h” parameters of a PNP transistor in common emitter mode.

4. To determine the frequency response of an IFT amplifier.

5. To determine voltage gain and plot the frequency response of a FET amplifier in common source mode.

6. To study the effect of negative feedback on voltage gain & bandwidth in a two stage amplifier

7. To determine frequency of a Hartley Oscillator circuit with change in the capacitor of the tank circuit.

8. To determine frequency and wave shape of a Colpitt’s oscillator circuit.

9. To determine frequency and wave shape of a crystal oscillator circuit.

10. To determine frequency and wave shape of a phase shift oscillator circuit.

11. To determine voltage gain and plot the frequency response of a single stage, two stage RC coupled and direct coupled amplifiers.

DIGITAL ELECTRONIC CIRCUITS LAB		Course Code: EC273	Credits: 1
No. of Lab (Hrs/Week): 2	No. of Lab Sessions (Sem.): 10	Mid Sem. Exam (Hrs): 0	End Sem. Exam (Hrs): 2

Suggested list of Experiments, but not limited to:

1. To verify the De-Morgan's theorems using NAND/NOR gates.
2. To design the full adder and half adder using AND, OR and X- OR gates.
3. To implement the logic circuits using decoder.
4. To implement the logic circuits using multiplexer.
5. To design parity generator and checker circuits.
6. To design and implement RS FLIP FLOP using basic latches.
7. Realization and testing of basic logic gates using discrete components.
8. Design 4 bit adder using IC 74283.
9. Design multiplexer using logic gates.
10. D-flip-flop using IC 7474, and verify D-flipflop work as toggle.
11. JK flip-flop using IC 7473.
12. Design T flipflop using JK flipflop.
13. Design 3 bit shift register using D-flip-flop.
14. Realization of 2 bit counter using IC 7473.
15. Realization of 3 bit counter using IC 7474.
16. Realization and testing of CMOS IC characteristics.
17. Realization and testing of TTL IC characteristics.
18. Realization and testing of RAM circuit using IC 7489.

NETWORK ANALYSIS LAB		**Course Code:** EC275	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. Implementation and verification of Maximum Power Transfer and Superposition theorem in ac circuits.
2. Implementation and verification of Thevnin's and Norton's theorem in ac circuits.
3. Implementation and verification of Tellegens theorem.
4. Implementation and verification of Reciprocity theorem.
5. Design and testing transient analysis in RC/RL circuits.
6. Design and testing of transient analysis in RLC circuits.
7. To calculate Z, Y, ABCD parameters of a given two port Networks.
8. Implementation and verification of transfer function of two port network.
9. To calculate image and characteristic impedance in T and π networks.
10. Implementation and verification of interconnection i.e. cascade, series, parallel, effect of loading of two port networks.
11. Design and implementation of K-derived LPF and HPF in T sections.

PCB DESIGN LAB		Course Code: EC277	Credits: 1
No. of Lab (Hrs/Week): 2	No. of Lab Sessions (Sem.): 10	Mid Sem. Exam (Hrs): 0	End Sem. Exam (Hrs): 2

Suggested list of Experiments, but not limited to:

Note: Design and test a PCB for a given circuit using following PCS design equipment:

1. PCB art work film maker
2. Artwork table
3. PCB shearing machine
4. Photo resist dip coating machine
5. UV exposure unit
6. Dye tank
7. Development tank
8. PCB etching machine
9. Drill machine
10. Solder able lacquer tank
11. PCB Curing Machine
12. Soldering Station

SEMESTER- IV

ANALOG COMMUNICATION		**Course Code:** EC222	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit 1: Introduction on Random Process
Overview of communication system, communication channels, need for modulation, baseband and pass band signals.
Random Process: Probability theory, random variables, statistical averages, transformation of random variables, random processes, stationary, mean, correlations and covariance functions, ergodicity, power spectral density and Gaussian process.

Unit II: Amplitude Modulation
Amplitude Modulation, Double side band with Carrier (DSB-C), Double side band without Carrier, Single Side Band Modulation, DSBSC, DSB-C, SSB Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator, Frequency division multiplexing, single side band transmission, comparison of various AM systems.

Unit III: Angle Modulation
Angle (Phase and frequency) Modulation, Mathematical Analysis, Deviation sensitivity, Waveforms, Phase deviation and modulation index, Frequency analysis of angle modulated system, Bandwidth requirement of angle modulated system, FM Modulators and Demodulators, Nonlinear effects in FM systems, FM Broadcasting, comparison of angle modulation and amplitude modulation.

Unit IV: Pulse Modulation
Sampling Theorem, Pulse Amplitude Modulation (PAM), Natural PAM Frequency Spectra for PAM , Flat-top PAM, Sample and hold circuits, Time division Multiplexing, PAM Modulator Circuit, Demodulation of PAM Signals, Pulse Time Modulation (PTM); Pulse Width Modulation(PWM), Pulse Position Modulation (PPM), PPM Demodulator.

Unit V: Noise in CW Modulation System
Internal noise (Thermal, shot, Transit time Miscellaneous); External noise (Atmospheric, Industrial, Extra Terrestrial); Noise calculations; Noise figure; Noise temperature, narrow band Noise, receiver model, Noise calculation in AM, DSB-SC, SSB, receivers, super-heterodyne receiver, noise in FM receivers, pre-emphasis and De-emphasis in FM.

Text Books:
[1] George Kennedy, Communication System, TMH
[2] B. P. Lathi, Modern Digital and Analog Communication System, Oxford University Press.

Reference Books:
[3] Simon Haykin , Communication Systems, John Wiley & Sons.
[4] Taub Schilling, Principles of Communication Systems, TMH.
[5] W. Tomasi, Electronic communications systems, Pearson Education.
[6] J. C. Hancock, An Introduction to the Principles of Communication Theory, McGraw Hill.
[7] J. G. Proakis, M. Salehi, Communications Systems Engineering, PHI.
[8] D. Roddy and J. Coolen, Electronic Communications, PHI.

LINEAR INTEGRATED CIRCUITS		**Course Code:** EC224	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Operational Amplifiers

Block diagram of a typical Op-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Change in Input offset voltage and Input offset current with time, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio.

Unit 2: Applications of Op-Amp

Summing amplifier, Integrator, Differentiator, Scaling and Averaging Amp, Instrumentation Amplifier, V to I and I to V converter, Log and Antilog Amp, Peak Detector, Sample and Hold Circuit, Op-amp as precision diode and its application in half and full wave rectifiers.

Unit 3: Frequency Response of Op-Amp and Active Filters

Frequency response, Compensating networks, Slew rate, causes of slew rate and its effect on applications. First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second order HP Butterworth filter, Higher order filters, Band pass filter, Band reject filters, All pass filter.

Unit 4: Comparators and Waveform Generators

Basic comparator, Zero crossing detector, Schmitt trigger, Square wave generator, Triangular wave generator, Saw tooth wave generator. **Timer:** Pin configuration, Block diagram, application of 555 IC as Monostable and Astable Multivibrator.

Unit 5: Phase Lock Loops: Basic operating principle, phase detector, voltage controlled oscillator (VCO), PLL IC 565, applications of PLL. **Voltage Regulators:** Discrete transistor shunt and series voltage regulators, IC voltage regulators, fixed voltage regulators, Adjustable voltage regulators, Boosting IC regulator output current, regulated power supplies, and switched mode power supply.

Text Books:

[1] D R Choudhury & S Jain, Linear integrated circuits, New Age International.
[2] Ramakant Gayakwad, Op Amps & Linear Integrated Circuits, Prentice Hall.

Reference Books:

[3] Coughlin & Driscoll, Op Amps & Linear Integrated Circuits, Pearson.
[4] Ravi Raj Dudeja, Op Amps & Linear Integrated circuits, Umesh Publications.
[5] Michael Jacob, Applications and Design with Analog Integrated Circuits, PHI.
[6] Jacob Milliman & Arvin Grabel, Microelectronics, TMH.

Microprocessor and Microcontrollers

Course Code:	EA226	Course Credits:	4
Course Category:	CC	Course (U / P)	U
Course Year (U / P):	2U	Course Semester (U / P):	1U
No. of Lectures + Tutorials (Hrs/Week):	03 + 01	Mid Sem. Exam Hours:	1.5
Total No. of Lectures (L + T):	45 + 15	End Sem. Exam Hours:	3

COURSE OBJECTIVES

1. Understand Basic and Advanced Microprocessor Architecture: Students will gain a foundational understanding of microprocessor architectures, particularly the 8085 and 8086, including their instruction sets, memory interfacing, and I/O operations.
2. Learn Microcontroller Architecture and Programming: Develop an understanding of microcontroller architecture, highlighting differences from microprocessors and acquiring basic programming skills in assembly language and C.
3. Explore Microcontroller Applications: Understand the application of microcontrollers in real-world scenarios including timers, counters, and serial communications, and learn to apply this knowledge in system automation and sensor integration.
4. Design Embedded Systems: Learn the principles of embedded system design including the use of real-time operating systems, system resource management, and integration of hardware and software components.
5. Develop System Integration Skills: Acquire skills in integrating various electronic components and software to create efficient, scalable, and robust embedded systems.

COURSE OUTCOMES

At the end of the course, the students should be able to:

1. CO1: Knowledge of Microprocessor Architecture - Understand the internal architecture of the 8085 and 8086 microprocessors, apply knowledge to assemble and run basic programs, and interface with memory and I/O devices.
2. CO2: Proficiency in Microcontroller Programming - Demonstrate ability to program microcontrollers using assembly and C, and analyze microcontroller architectures to select optimal solutions for specific applications.

3. CO3: Practical Application of Microcontrollers - Design and implement practical applications using microcontrollers for tasks such as motor control and sensor integration, evaluate the effectiveness of these solutions in real-world applications.
4. CO4: Embedded System Design - Analyze the requirements for embedded systems including power optimization and system resource management, and create integrated systems using appropriate software and hardware components.
5. CO5: System Integration and Problem Solving - Integrate knowledge of microprocessors, microcontrollers, and embedded systems to solve complex problems in system design, demonstrating creativity and innovation in developing practical solutions.

Unit I: Fundamentals of Microprocessor

Detailed discussion on the internal architecture of the 8085, Introduction to the instruction set, Basics of assembly language programming, Overview of memory interfacing and basic input/output operations, providing a foundation for more complex systems.

Unit II: Advanced Technologies

Examination of the 8086 , architecture, signal description, and bus operations, addressing capabilities, segmentation, and physical memory organization, highlight the differences and advancements from 8085 to 8086, enhancing understanding of evolution.

Unit III: Introduction to Microcontrollers

Basic concepts of microcontroller architecture, differentiating from .s with emphasis on integrated functions and resource optimization, Basic programming skills using both assembly language and C, Techniques for integrating internal and external peripherals using microcontrollers.

Unit IV: Microcontroller Applications and Programming

Use of timers, counters, serial communication, and interrupt-driven programming, Overview of practical applications like motor control, sensor integration, and system automation, Exploration of various development environments and tools used for microcontroller programming.

Unit V: Embedded Systems Design

Principles of embedded system design, including real-time operating systems (RTOS), system resource management, and power optimization, Methods for integrating hardware and software components to design robust and scalable embedded systems.

Text Books:

1. "Microprocessor Architecture, Programming, and Applications with the 8085" by Ramesh S. Gaonkar -
2. "The 8051 Microcontroller and Embedded Systems Using Assembly and C" by Muhammad Ali Mazidi, Janice Gillispie Mazidi, and Rolin D. McKinlay "
3. Embedded Systems: Architecture, Programming and Design" by Raj

Reference book:

1. "Advanced Microprocessors and Peripherals" by A.K. Ray and K.M. Bhurchandi
2. "Embedded System Design" by Peter Marwedel
3. "Fundamentals of Microcontrollers and Applications in Embedded Systems with PIC Microcontrollers" by Ramesh Gaonkar.

Microprocessor and Microcontroller LAB			
Course Code:	**EA 274**	**Course Credits:**	**1**
Course Category:	**CC-P**	**Course (U / P)**	**U**
Course Year (U / P):	**1U**	**Course Semester (U / P):**	**3U**
No. of Labs (Hrs/Week):	**1(2 hrs)**	**Mid Sem. Exam Hours:**	
Total No. of Labs :	**10**	**End Sem. Exam Hours:**	**2**

COURSE OBJECTIVES
1. Develop Programming Skills: Enhance skills in programming microprocessors and microcontrollers for basic arithmetic operations and data manipulation.
2. Understand System Interfacing: Learn the fundamentals of interfacing microprocessors and microcontrollers with various peripheral devices to perform specific tasks.
3. Apply Communication Protocols: Apply serial communication protocols to enable data exchange between microcontrollers and other devices.
4. Implement Microcontroller Applications: Gain practical experience in applying microcontroller programming to solve real-world problems like traffic light control and system automation.
5. Project Development and Integration: Encourage creative thinking and problem-solving through the design and implementation of a comprehensive project that integrates learned skills in a real-world application.

COURSE OUTCOMES
At the end of the course, the students should be able to:
1. CO1: Arithmetic Operations on Microprocessors - Ability to program microprocessors to perform basic arithmetic operations such as addition, subtraction, and multiplication.
2. CO2: Data Management - Analyze and implement algorithms to manage data, including transferring blocks of data and sorting data in a specified order.

3. CO3: Peripheral Device Interfacing - Demonstrate skills in interfacing microprocessors with peripheral devices such as the 8255 PPI and 8257/8237 DMA controllers, and utilizing RS232 for serial communication.
4. CO4: Microcontroller Programming and Interface Applications - Develop and implement microcontroller-based applications, including external device control (LEDs, LCDs) and complex systems such as a traffic light controller.
5. CO5: Design and Project Implementation - Design, implement, and evaluate a microcontroller-based project that synthesizes various components and programming skills into a functional system.

List of Experiments

1. Addition of two 8-bit numbers.
2. Subtraction of two 8-bit numbers.
3. Multiplication of two 8-bit numbers. (Blank)
4. Data block transfer of a non-overlapping memory segment.
5. Arranging a data block in ascending order.
6. Interfacing of programmable peripheral interface 8255.
7. Interfacing of DMA Controller 8257/8237.
8. Serial communication using RS232.
9. Programming 8051 microcontroller for external LED blinking.
10. Interfacing and initialization of input and output ports using 8055.
11. Implementing timer/counter operations in 8051.
12. UART communication in 8051.
13. Interfacing a 16x2 LCD with 8051.
14. Creating and running a small traffic light control system.
15. Small project implementation using microcontrollers (to be defined by each group).

ELECTROMAGNETIC FIELD THEORY		Course Code: EC228	Credits: 4
No. of Lectures (Hrs/Week): 4	No. of Lectures (Sem.): 60	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: Vector Analysis and Electrostatics
Vector Analysis: Vector algebra, dot and cross products, Coordinate systems, Relation in rectangular, cylindrical, and spherical coordinate systems, concept of differential line, differential surface and differential volume in different coordinate systems.
Electrostatics: Coulomb's law, electric field intensity, fields due to different charge distributions, electric flux density, gauss law of electrostatics, divergence theorem, electric potential, relations between E and V, Maxwell's equations for electrostatic fields, energy density, convection and conduction currents, continuity equation, boundary conditions, dielectrics materials, boundary conditions, capacitance – parallel plate, coaxial, spherical capacitors, Poisson's and Laplace's equations.

Unit II: Magnetostatics and Maxwell's Equations (Time Varying Fields)
Magnetostatics: Biot-Savart law, Ampere's circuital law, magnetic flux density, curl, Stoke's theorem, Maxwell's two equations for static EM fields, magnetic scalar and vector potentials, forces due to magnetic fields, Ampere's Force law, inductances and magnetic energy.
Maxwell's Equations (Time Varying Fields): Faraday's law and emf, concept of displacement current density, Maxwell's equations in integral and differential forms, retarded potential.

Unit III: Transmission Lines: Definition of characteristic impedance and propagation constant, general solution of the transmission line–the two standard forms for voltage and current of a line terminated by impedance, input impedance of a lossless line terminated by impedance, meaning of reflection coefficient–wavelength and velocity of propagation, distortion less transmission line, standing wave ratio on a line, the quarter wave line and impedance matching, single stub matching and double stub matching, Smith chart, application of the smith chart, conversion from impedance to reflection coefficient and vice-versa.

Unit IV: Electromagnetic Waves
Wave propagation in free space, conducting and perfect dielectric media, Skin effect, Poynting vector and Poynting theorem, wave polarization.

Unit V: Plane Waves Reflection and Dispersion
Reflection of wave at normal incidence and multiple interfaces wave propagation in general direction, reflection at oblique incident angles, Brewster angle, total refection and transmission of obliquely incident wave, wave propagation and pulse broadening in dispersive media.

Text Books:
[1] William H. Hayt Jr. and John A. Buck, Engineering Electromagnetic, TMH.
[2] R.K. Shevgaonkar, Electromagnetic Wave, TMH.

Reference Books:
[3] Edminister, Electromagnetic (Schaum's Outlines Series), TMH.
[4] J. D Kraus, Electromagnetic with Applications, TMH
[5] Mathew O Sadiku, Elements of Electromagnetics, Oxford University Press.
[6] D K Cheng: Field and Wave Electromagnetics, Addison Wesley**.**

DATA STRUCTURES USING C		Course Code: CS214	Credits: 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction To Data Structures: Abstract data types, sequences as value definitions, data types in C, pointers in C, data structures and C, arrays in C, array as ADT, one dimensional array, implementing one dimensional array, array as parameters, two dimensional array, structures in C, implementing structures, Unions in C, implementation of unions, structure parameters, allocation of storage and scope of variables, recursive definition and processes: factorial function, fibonacci sequence, recursion in C, efficiency of recursion, hashing, hash function, open hashing, closed hashing: linear probing, quadratic probing, double hashing, rehashing, extendible hashing.

Unit II: Stack, Queue And Linked List: Stack definition and examples, primitive operations, example -representing stacks in C, push and pop operation implementation, queue as ADT, C Implementation of queues, insert operation, priority queue, array implementation of priority queue, inserting and removing nodes from a list-linked implementation of stack, queue and priority queue, other list structures, circular lists: stack and queue as circular list - primitive operations on circular lists, header nodes, doubly linked lists, addition of long positive integers on circular and doubly linked-list.

UNIT III: Trees: Binary trees: operations on binary trees, applications of binary trees, binary tree representation, node representation of binary trees, implicit array representation of binary tree, binary tree traversal in C, threaded binary tree, representing list as binary tree, finding Kth element, deleting an element, trees and their applications: C representation of trees, tree traversals, evaluating an expression tree, constructing tree.

UNIT IV Sorting And Searching: General background of sorting: efficiency considerations, notations, efficiency of sorting, exchange sorts: bubble sort; quick sort; selection sort; binary tree sort; heap sort, heap as a priority queue, sorting using a heap, heap sort procedure, insertion sorts: simple insertion, shell sort, address calculation sort, merge sort, radix sort, sequential search: indexed sequential search, binary search, interpolation search.

UNIT V GRAPHS: Application of graph, C representation of graphs, transitive closure, Warshall's algorithm, shortest path algorithm, linked representation of graphs, Dijkstra's algorithm, graph traversal, traversal methods for graphs, spanning forests, undirected graph and their traversals, depth first traversal, application of depth first traversal, efficiency of depth first traversal, breadth first traversal, minimum spanning tree, Kruskal's algorithm, round robin algorithm.

Text Books:

[1] Aaron M. Tenenbaum,Yedidyah Langsam and Moshe J. Augenstein "Data Structures Using C and C++", PHI Learning Private Limited, Delhi India.
[2] Jean Paul Trembley and Paul G. Sorenson, "An Introduction to Data Structures with applications", McGraw Hill.

Reference Books:

[3] Horowitz and Sahani, "Fundamentals of Data Structures", Galgotia Publications Pvt Ltd Delhi India.
[4] E. Balagurusamy, 'Programming in Ansi C', 2nd Edition, TMH, 2003.
[5] Rajesh K. Shukla, "Data Structure Using C and C++" Wiley Dreamtech Publication.
[6] Lipschutz, "Data Structures" Schaum's Outline Series, Tata Mcgraw-hill Education (India) Pvt. Ltd.
[7] Michael T. Goodrich, Roberto Tamassia, David M. Mount "Data Structures and Algorithms in C++", Wiley India.
[8] Robert L. Kruse, Bruce P. Leung Clovis L.Tondo,"Data Structures and Program Design in C", Pearson Education
[9] Berztiss, A.T.: Data structures, Theory and Practice, Academic Press.

II-YEAR (IV-SEMESTER)

ANALOG COMMUNICATION LAB		**Course Code:** EC272	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. Design and testing of an amplitude modulator & demodulator circuit and determine the depth of modulation.
2. Design and testing of a frequency modulator & demodulator circuit and determine the modulation index.
3. Design and testing of a phase modulator & demodulator circuit and determine the standard deviation.
4. Design and tracing the signals at various points of a pulse amplitude modulator and demodulator circuit.
5. Design and tracing the signals at various points of a pulse position modulator and demodulator circuit.
6. Design and tracing the signals at various points of a pulse width modulator and demodulator circuit.
7. Implementation and verification of frequency division multiplexer & de-multiplexer.
8. Design and tracing the signals at various points of a DSB-SC modulator and demodulator circuit.
9. Design and tracing the signals at various points of a SSB-SC modulator and demodulator circuit.
10. Verification and of Sampling theorem and reconstruction of its equivalent analog signal.
11. Design and tracing the signals at various points of a Delta modulation & demodulation modulator and demodulator circuit.

LINEAR INTEGRATED CIRCUITS LAB		**Course Code:** EC276	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. To design voltage and verify the op-amp working as:
    a. Unity Gain amplifier.
    b. Inverting amplifier.
    c. Non Inverting amplifier.
2. Design & test a difference amplifier using operational amplifier.
3. Design & test a constant current source with grounded load operational amplifier.
4. Design an active second order low pass filter using operational amplifier & plot the Frequency response characteristics.
5. Design an active second order high pass filter using operational amplifier and plot the frequency response characteristics.
6. Design and test a square wave generator using operational amplifier.
7. Design and test a triangular wave generator using operational amplifier.
8. Design and test a mono stable multivibrator using Timer IC 555.
9. Design and test an astable multivibrator using Timer IC 555.
10. Design and test IC voltage regulator circuits using ICs 723/7805/7905.
11. Determine the locking and capture range of a PLL IC 565.

DATA STRUCTURES LAB		Course Code: CS288	Credits: 1
No. of Lab (Hrs/Week): 2	No. of Lab Sessions (Sem.): 10	Mid Sem. Exam (Hrs): 0	End Sem. Exam (Hrs): 2

Suggested list of Experiments, but not limited to:

List of Experiments:

1. Run time analysis of Fibonacci Series
2. Study and Application of various data Structure
3. Study and Implementation of Array Based Program
    a. Searching (Linear Search, Binary Search)
    b. Sorting (Bubble, Insertion, Selection, Quick, Merge etc)
    c. Merging
4. Implementation of Link List
    a. Creation of Singly link list, Doubly Linked list
    b. Concatenation of Link list
    c. Insertion and Deletion of node in link list
    d. Splitting the link list into two link list
5. Implementation of STACK and QUEUE with the help of
    a. Array
    b. Link List
6. Implementation of Binary Tree, Binary Search Tree, Height Balance Tree
7. Write a program to simulate various traversing Technique
8. Representation and Implementation of Graph
    a. Depth First Search
    b. Breadth First Search
    c. Prims Algorthim
    d. Kruskal's Algorithms
9. Implementation of Hash Table.

SEMESTER-V

DIGITAL LOGIC DESIGN USING VERILOG		Course Code: EC331	Credits: 3
No. of Lectures (Hrs/Week): 3	No. of Lectures (Sem.): 45	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit 1

ASIC Design Flow, Architecture and configuration of (Xilinx)Virtex series FPGA, Principles Hardware Description Languages, Y-Chart, Types of HDLs, Introduction to Verilog, Language Constructs ,Modeling styles.

Unit 2

Gate Level Modeling: Modeling using Verilog gate primitives, description of various gates, fall, rise and turn off delays, min, max and typical delay. Dataflow modeling: Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

Unit 3

Behavioral Modeling: Structured procedures, initial and always, blocking and non-blocking statements delay control, Conditional Statements, Multi-way branching statement loops, Procedural statements, stratified event queue, sequential and parallel blocks, Delay based timing control, event-based timing control, Level sensitive timing control, sequential and parallel blocks

Unit 4

Introduction to Task and functions, difference between task and functions, Task declaration and invocation, Function declaration and Invocation, Assign-de assigned construct, force release constructs, User defined primitives.

Unit 5

Design of Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter. Finite state machine, state table, Mealy FSM , Moore FSM

Text Books:

[1] Verilog HDL by Samir Palnitkar, Pearson Pub.
[2] M. Ercegovac, T. Lang and L.J. Moreno, ”Introduction to Digital Systems”, Wiley,2000

Reference Books:

[1] Digital Design by Frank Vahid, Wiley, 20063.
[2] Introduction to Digital Systems by M. Ercegovac, T. Lang and L.J. Moreno, Wiley,2000.
[3] Fundamental of digital Logic with Verilog design by S. Brown & Z. Vransesic, TMH.
[4] Design through Verilog HDL by T.R. Padmanabhan& B. Bala Tripura Sundari, Wiley Pub. 2007

DIGITAL COMMUNICATION		**Course Code:** EC323	**Credits:** 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I:
Sampling of Signal, Sampling Theorem for Low Pass and Band Pass Signals, Aliasing, Pulse Amplitude Modulation, Time Division Multiplexing, Channel Bandwidth for PAM-TDM Signal, Types of Sampling, Instantaneous, Natural and Flat Top-Mathematical and Spectral Analysis, Aperture Effect, Introduction to Pulse Position and Pulse Duration Modulation.

Unit II: Pulse Code Modulation
Quantization, Quantization Error, Pulse Code Modulation, Signal-to-Noise Ratio in PCM, Companding, Data Rate and Bandwidth of Multiplexed PCM Signal, Inter-symbol Interference, Eye Diagram, Line Coding ,Differential PCM, Delta Modulation, Adaptive Delta Modulation Slope Overload Error ,Granular Noise ,Comparison of various system in terms of Bandwidth and Signal-to-Noise Ratio.

Unit III: Digital Modulation Techniques
Analysis, Generation and Detection , Spectrum and Bandwidth of Amplitude Shift Keying, Binary Phase Shift Keying, Differential Phase Shift Keying , Quadrature Phase Shift Keying, M-ary PSK, Binary Frequency Shift Keying, M-ary FSK, Minimum Shift Keying, Quadrature Amplitude Modulation.

Unit IV: Errors
Probability of error, bit error rate, Comparison of digital modulation techniques on the basis of probability of error, Matched Filter.

Unit V:
Line Coding: Unipolar RZ and NRZ, Bipolar RZ and NRZ, AMI, Split Phase etc. Properties for the selection of Line Codes, HDB Signaling , B8ZS Signaling, Inter-symbol Interference, Nyquist Criteria for Zero ISI, Differential Coding, Regenerative Repeaters, Eye Diagram.

Text Books:
[1] B. Sklar: Digital Communication, Pearson Education
[2] Haykin Simon: Digital Communication, Wiley Publication.

Reference Books:
[3] Taub & Schilling, Principles of Communication System, TMH.
[4] Lathi B.P., Modern Analog and Digital Communication Systems, Oxford Uni. Press.
[5] Proakis, Digital Communication, McGraw Hill.
[6] Schaum's Outline Series, Analog and Digital Communication.
[7] Tomasi, Advanced Electronics Communication Systems, PHI.
[8] Singh and Sapre, Communication System, TMH.
[9] Couch, Digital and Analog Communication, Pearson Education.

ANTENNA AND WAVE PROPAGATION		Course Code: EC325	Credits: 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Review of Electromagnetic Theory.

Antenna as transducer, operating spectrum, Mathematical background, Maxwell's Equation and its physical interpretation, Wave equation and its solution, wave polarization, wave phase velocity, wave power flow and Poynting Vector. Antenna as impedance: transformation and matching, power transfer between antenna and medium, Impedance/Admittance Smith Chart.

Unit II: Radiation Mechanism and Antenna Parameters

Potential function, Radiated Fields from a Hertzian dipole, half wave dipole and quarter wave monopole, Power radiated and radiation resistance, Radiation parameters of a transmitting and receiving Antenna, Reciprocity principle, Effective length, Effective area and radiation resistance, antenna temperature. FCC Antenna standards A and B, Measurements - radiation pattern- Gain- Directivity and Impedance.

Unit III: Antenna Arrays

Array of two point sources, array factor, n-element linear array with uniform amplitude and spacing, analysis of broadside array, ordinary end-fire array, Hansen-Woodyard end fire array, n-element linear array with non-uniform spacing, analysis of binomial and Dolph-Tschebyscheff array, scanning array, super directive array.

Unit IV: Types of Antennas

HF, VHF and UHF antennas: folded dipole, V-antenna, rhombic antenna, Yagi-Uda antenna, log-periodic antenna, loop antenna, radiation field from short magnetic dipole, microwave antennas helical antenna, microstrip antenna, horn antenna, parabolic dish, RF- MEMS Antenna, etc.

Unit V: Wave Propagation

Friis free space equation, reflection from earth's surface, surface and space wave propagation, field strength of space wave, range of space wave propagation, effective earth's radius, effect of earth imperfections and atmosphere on space wave propagation, modified refractive index, duct propagation, tropospheric propagation, structure of ionosphere, propagation of radio waves through ionosphere, refractive index of ionosphere, reflection and refraction of waves by ionosphere, critical frequency, maximum usable frequency, optimum working frequency, lowest usable high frequency, virtual height, skip distance, effect of earth's magnetic field.

Text Books:

[1] A K Gautam, Antenna and Wave propagation, Kataria & Sons.
[2] C. A. Ballanis: Antenna Theory, John Wiley & Sons.
[3] R.K. Shevgaonkar, Electromagnetic Wave, TMH.

Reference Books:

[4] D. K. Cheng, Fields and Waves Electromagnetics, Addison-Wesley.
[5] J.D. Kraus, Antennas for All Applications, McGraw Hill.
[6] R. E. Collins: Antennas and Radio Propagation, McGraw-Hill.
[7] E.C. Jordan & Balman: Electro Magnetic Waves and Radiating Systems, PHI.
[8] G.S.N. Raju: Antenna and Wave Propagation, Pearson Education.
[9] D. J. Griffiths, Introduction to Electrodynamics, PHI.

CONTROL SYSTEM		Course Code: EC327	Credits: 4
No. of Lectures (Hrs/Week): 4	No. of Lectures (Sem.): 60	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: General Introduction to Control System and Transfer Function

General Introduction to Control System: Historical background, open-loop and closed loop control systems, basic elements of a feedback control system, types of feedback control systems, effects of feedback.

Transfer Function: Laplace transform and inverse Laplace transform, differential equations of physical systems, poles and zeros, characteristic equation; Block diagrams: representation and reduction; Signal flow graphs: definitions, properties, gain formula; analogous systems.

Unit II: Time Response Analysis and Concept of Stability

Time Response Analysis: Standard test signals, response of first and second order systems, time response specifications, steady state errors, types of control systems, static error constants; effects of addition of poles and zeros.

Concept of Stability: Definition, absolute and relative stability, asymptotic stability; Routh-Hurwitz stability criterion: stability conditions, Hurwitz criterion, Routh-array, special cases, relative stability analysis, design applications. Root locus technique: root locus, complementary root locus and root contours, basic fundamentals, construction rules, effects of addition of poles and zeros.

Unit III: Frequency Domain Analysis

Frequency response specifications, correlation between time and frequency response, Bode plot, Polar plot, Nyquist stability criterion, gain and phase margins; Closed-loop frequency response: M-circles, N-circles, closed-loop frequency response for unity and non-unity feedback systems.

Unit IV: Automatic Controllers and Compensation Techniques and Digital control System

Automatic Controllers: Basic control actions, PD, PI and PID controllers, effect on the time response.

Compensation Techniques: classifications, lead, lag and lag-lead compensations.

Digital Control Systems: Introduction, sampling theorem, Jury's stability criterion.

Unit V: State Space Analysis

Concepts of states, state variables, and state model; state models of linear systems; state-transition matrix; solution of state equations, various canonical forms, transfer matrix; characteristic equation; eigenvalues and eigenvectors; derivation of transfer function from state model, Introduction of State space representation of digital system, Controllability and Observability tests.

Text Books:

[1] Nagrath & Gopal, Control System Engineering, New Age International.
[2] K. Ogata, Modern Control Engineering, PHI.

Reference Books:

[3] B. C. Kuo & Farid Golnaraghi, Automatic Control System, Wiley.
[4] D. Roy Choudhary, Modern Control Engineering, PHI.

CONTROL SYSTEM LAB		Course Code: EC371	Credits: 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. To determine response of second order systems for step input for various values of constant 'k' using linear simulator unit and compare theoretical and practical results.
2. To verify and compare the performance of P, PI and PID temperature controller for an oven.
3. To determine the performance of a dc position Control System.
4. To obtain transfer characteristics of a synchro- transmitter and receiver.
5. To determine speed–torque characteristics of an ac servomotor.
6. To determine the performance parameters of a dc servo motor.
7. To analyze the behavior of dc motor in open loop at various loads.
8. To design and test a lag, lead and lag-lead compensator using Bode plot.
9. To calculate the basic step angle of a stepper motor
10. To verify the response of a digital controller over a second order simulated process.
11. To verify the frequency response analysis of the dc servomotor control system using PID controller.
12. To position the D.C Servomotor to required degree using DSP Controller.

DIGITAL COMMUNICATION LAB		**Course Code:** EC373	**Credits:** 1
No. of Lectures (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. To verify the Sampling Theorem.
2. To study ASK (Amplitude Shift Keying) System.
3. Modulate a Digital Signal using Amplitude Shift Keying.
4. Demodulate an Amplitude Shift Keyed Signal.
5. To study FSK (Frequency Shift Keying) System.
6. Modulate a Digital Signal using Frequency Shift Keying.
7. Demodulate a Frequency Shift Keyed Signal.
8. To study BFSK (Binary Frequency Shift Keying) System.
9. Modulate a Digital Signal using Binary Frequency Shift Keying.
10. Demodulate a Binary Frequency Shift Keyed signal.
11. To study PSK (Phase Shift Keying) System.
12. Modulate a Digital Signal using Phase Shift Keying.
13. Demodulate a Phase Shift Keyed Signal.
14. To study BPSK (Binary Phase Shift Keying) System.
15. Modulate a Digital Signal using Binary Phase Shift Keying.
16. Demodulate a Binary Phase Shift Keyed Signal
17. To study QPSK (Quadrature Phase Shift Keying) System.
18. Modulate a Digital Signal using Quadrature Phase Shift Keying.
19. Demodulate a Quadrature phase shift keyed signal.
20. To study DPSK (Differential Phase Shift Keying) System.
21. Modulate a Digital Signal using Differential Phase Shift Keying.
22. Demodulate a Differential Phase Shift Keying.
23. To study Pulse Code Modulation System (PCM) System.
24. Generate, Modulate and Transmit a Pulse Coded Signal.
25. Receive and Demodulate a Pulse Coded Signal..
26. To study TDM (Time Division Multiplexing) System.
27. Generate and Transmit a TDM Signal.
28. Receive and De-multiplex a TDM Signal.
29. To study M-ARY FSK Modulation and Demodulation.
30. To study and implement the Cyclic Redundancy Check.
31. To study the circuit of PAM Modulator and Demodulator.
32. To study the circuit of PWM Modulator and Demodulator.
33. To study the circuit of PPM Modulator and Demodulator.

III-YEAR (V-SEMESTER)

MICRO – CONTROLLER AND EMBEDDED SYSTEM LAB		**Course Code:** EC375	**Credits:** 2
No. of Lab (Hrs/Week): 3	**No. of Lab Sessions (Sem.):** 15	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 3

Suggested list of Experiments, but not limited to:

1. Addition of two 8 bit numbers.
2. Addition of two 16 bit numbers
3. Addition of a series of numbers.
4. Subtraction of two 8 bit numbers.
5. Multiplication of two 8 bit numbers.
6. Division of two 8 bit numbers.
7. 1's complement of an 8 bit number.
8. 2's complement of an 8 bit number.
9. Square of a number using look up method.
10. Data block transfer of a non-overlapping memory segment.
11. Data block transfer of an overlapping memory segment.
12. Arrange the data block in ascending order.
13. Arrange the data block in descending order.
14. Addition of only even numbers from a series of numbers.
15. Addition of only odd numbers from a series of numbers.
16. Counting the number of 1's in a data byte.
17. Counting the number of 0's in a data byte.
18. Smallest number in an array.
19. Largest number in an array.
20. Interfacing of programmable peripheral interface 8255.
21. Interfacing and initialization of input and output ports using 8255.
22. Interfacing of programmable interval timer 8254/8254.
23. Interfacing of DMA Controller 8257/8237.
24. Interfacing of programmable interrupt controller 8259.
25. Interfacing of Universal Synchronous Asynchronous Receiver Transmitter 8251.
26. Serial communication using RS232.
27. Code conversions (HEX to ASCII etc.)
28. Small project (to be done by each group)

III-YEAR (V-SEMESTER)

ANTENNA AND WAVE PRAPOGATION LAB		**Course Code:** EC377	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

Note: The experiments will be performed using Simulation Software CST, HFSS, ADS, and MATLAB.

1. Analysis of Lossless Transmission Line Analysis
2. Radiation Pattern Analysis of Dipole, Monopole, and Loop Antenna
3. Radiation Pattern Analysis of Circular Array, Travelling wave, and linear array.
4. Implementation of Isotropic Antenna.
5. Estimation of Antenna Directivity Parameter.
6. Numerical Evaluation of Directivity for a Half Wave Dipole Antenna.
7. Radiation Pattern Analysis of Horn Antenna.
8. Realization of Optimized six elements Yagi-Uda Antenna.
9. 3-D Radiation Pattern Analysis of Binomial Antenna array,
10. Modeling of Microstrip Antenna.
11. Modeling of Parabolic Reflector Antenna.
12. Modeling of Array Antenna.

DIGITAL LOGIC DESIGN LAB		**Course Code:** EC 375	**Credits: 1**
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 15	**Mid Sem. Exam (Hrs):**	**End Sem. Exam (Hrs):** 3

List of Experiments:

1. To study and verify the waveform for all basic gates using behavior modeling.
2. To study and verify the waveform for half adder and full adder using data flow modeling.
3. Design and verify the waveform for half subtractor using data flow modeling.
4. Design and verify the waveform for 2*1 multiplexor and 4*1 multiplexor using structural modeling.
5. Design and verify the waveform for 8*1 Mux using 2*1 mux using structural modeling.
6. Design and verify the waveform for decoder and encoder using behavioural modeling.
7. Design and verify the waveform for even and odd parity checker using structural and behavioural modeling.
8. Design and verify the waveform for S-R flip-flop using behavioural modeling and structural modeling.
9. Design and verify the waveform for D and T flipflop using behavioural modeling.
10. Understanding and working of FPGA using verilog programming for basic gates.

Elective-1

III-YEAR (V-SEMESTER)

(Elective-1)

III-YEAR (V-SEMESTER)

(Elective-1)

ELECTRONICS INSTRUMENTATION AND MEASUREMENTS		**Course Code:** EC343	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Theory of Errors and Bridges and AC Bridges

Theory of Errors and Bridges: Accuracy & precision, Repeatability, Limits of errors, Systematic & random errors, Modeling of errors, Probable error & standard deviation, Gaussian error analysis, Combination of errors.

Method of measuring low, medium and high resistance – sensitivity of Wheat stones bridge – Carey Foster's bridge, Kelvin's double bridge for measuring low resistance.

AC Bridges: Measurement of inductance, Maxwell's bridge, Hay's bridge, Anaderson's bridge, Owen's bridge – Heaviside Bridge and its modifications, Measurement of capacitance, equivalent circuit of an imperfect capacitor – Desauty bridge, Wien's bridge, Schering Bridge.

Unit II: Electronic Instruments for Measuring Basic Parameters

Electronic Voltmeter, Electronic Multimeters, Digital Voltmeter, Component Measuring Instruments, Q meter, Vector Impedance meter, RF Power & Voltage Measurements, Measurement of frequency, Introduction to shielding & grounding.

Unit III: Oscilloscopes

CRT Construction, Basic CRO circuits, CRO Probes, Oscilloscope Techniques of Measurement of frequency, Phase Angle and Time Delay, Multibeam, multi trace, storage & sampling Oscilloscopes. Curve tracers.

Unit IV: Signal Generation

Sine wave generators, Frequency synthesized signal generators, Sweep frequency generators. Signal Analysis **–** Measurement Technique, Wave Analyzers, Frequency- selective wave analyzer, Heterodyne wave analyzer, Harmonic distortion analyzer, Spectrum analyzer.

Unit V: Transducers

Classification, Selection Criteria, Characteristics, Construction, Working principles, Application of following Transducers- RTD, Thermocouples, Thermistors, LVDT, RVDT, Strain Gauges, Bourdon Tubes, Bellows. Diaphragms, Seismic Accelerometers, Tachogenerators, Load Cell, Piezoelectric Transducers, Ultrasonic Flow Meters, Instrument transformers – CT and PT – Ratio and phase angle errors–design considerations–Testing of CT's –Silsbee's method – Variable mutual inductance methods.

Text Books:

[1] H S Kalsi, Electronic Instrumentation, TMH
[2] Bernard Oliver, Electronic Measurements & Instrumentation, TMH
[3] B.C.Nakra & K.K. Chaudhry, Instrumentation Measurement & Analysis, TMH

Reference Books:

[4] Bernard Oliver & John Cage, Electronic Measurements & Instrumentation, TMH
[5] Lal Kishore, Electronic Measurements and Instrumentation, Pearson.
[6] Carr, Elements of Electronic Instrumentation and Measurement, Pearson.
[7] Bell, Electronic Instrument and Measurement, Oxford.
[8] Dally, Electronic Measurements and Instrumentation, Wiley.
[9] Figliola, Theory and Design for Mechanical Measurements, Wiley.
[10] David A. Bell, Electronic Instrumentation and Measurements, PHI.
[11] Arun K. Ghosh, Introduction To Measurements And Instrumentation, PHI.
[12] A.K.Sawhney, A Course In Electrical & Electronic Measurement & Instrumentation, Dhanpat Rai Publication.

III-YEAR (V-SEMESTER)

(Elective-1)

DIGITAL IMAGE PROCESSING		**Course Code:** EC345	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit 1: Digital Image Fundamentals and Transforms:

Elements of visual perception – Image sampling and quantization Basic relationship between pixels – Basic geometric transformations-Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT– Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar, Slant – Karhunen – Loeve transforms.

UNIT II: Image Enhancement Techniques

Spatial Domain methods: Basic grey level transformation – Histogram equalization – Image subtraction – Image averaging – Spatial filtering: Smoothing, sharpening filters – Laplacian filters – Frequency domain filters: Smoothing – Sharpening filters – Homomorphic filtering.

UNIT III: Image Restoration and Compression

Model of Image Degradation/ restoration process – Noise models, restoration by spatial filtering, Inverse filtering -Least mean square filtering –Constrained least mean square filtering – Blind image restoration – Pseudo inverse – Singular value decomposition Wiener filtering, image reconstruction from Projection.

Unit IV: Image Compression

Fundamentals of data compression- basic compression methods: Huffman coding, Golomb coding, LZW coding, Run-Length coding, Symbol based coding. Digital Image Watermarking, Representation and Description- minimum perimeter polygons algorithm (MPP).

Unit V: Image Segmentation and Representation

Edge detection–Thresholding-Region Based segmentation – Boundary representation: chair codes- Polygonal approximation– Boundary segments – boundary descriptors: Simple descriptors-Fourier descriptors – Regional descriptors –Simple descriptors-Texture.

Text Books:

[1] Rafael C Gonzalez & Richard E Woods, Digital Image Processing, Pearson Education.
[2] William K Pratt, Digital Image Processing, John Willey.

Reference Books:

[3] A.K. Jain, Fundamentals of Digital Image Processing, PHI.
[4] Chanda Dutta Magundar, Digital Image Processing and Applications, Prentice Hall of India.

III-YEAR (V-SEMESTER)

(Elective-1)

ELECTRONICS COMMERCE		**Course Code:** EC347	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

UNIT I

Ecommerce and E-Business, Overview of E-Business; Information Services; Shopping Services; Virtual Enterprises, Need of E-Commerce; The Emerging landscape forces affecting E-Commerce; Economic potential of E- Commerce; Business dimension and technological dimension of E-Commerce

UNIT II

E-Commerce industry frame work; Ecommerce models, Internet as an E-Commerce enabler handling business transactions; Handling payments: Electronic Fund Transfer System, Digital Token an notational based electronic payment system, smart card, credit card and emerging financial instruments

UNIT III

Introduction to mobile commerce; Frame required for mobile computing; Challenges emerging in mobile commerce security considerations, Wireless Application Protocols, WAP Technology

UNIT IV

Ecommerce applications; E-Commerce and Banking: changing dynamics in banking industry; Home banking and its implementation; Management issues in on-line banking, E-Commerce and retailing: On-line retail industry dynamics; On-line mercantile models from customer perspective; Management challenges in on-line retailing. E-Commerce and on-line publishing: On-line publishing approach from customer prospective; Supply chain management fundamentals; Intranets and Supply Chain Management; Managing retail supply chains, Supply chain Application Software, EDI: EDI application in business development; EDI technology; EDI as a re-engineering tool; Financial EDI, Customer Relationship Management.

UNIT V

Web security: Introduction; Firewalls and transaction security; Client server network security; Emerging client service security threats; Data security; Inscription secret key and inscription; Legal Implications of E-Business, transaction; Cyber laws and implementation of cyber laws

Text Books:

1. Ecommerce business, technology, society, Laudon & Traver, Pearson Education.
2. Ecommerce Strategy, Technologies and Applications, David whitley, Tata McGraw Hills.
3. E-Business and E-Commerce Management, Dave Chaffey, 3rd Edition, Pearson Education.
4. E-Commerce An Indian perspective, Joseph, P.T. 3rd Edition, PHI.

III-YEAR
(VI-SEMESTER)

III-YEAR (VI-SEMESTER)

FUNDAMENTALS OF ELECTRO-OPTICS AND PHOTONICS		**Course Code:** PHUD 414	**Credits:** 3
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

PHUD414: FUNDAMENTALS OF ELECTRO-OPTICS AND PHOTONICS

3-Credits (3-0-0)

Foundations of Optical Engineering: [08]
Introduction to Electromagnetic Field Theory: Maxwell's equations, Boundary conditions and their implications in optics; Energy Level Distributions and Semiconductor Physics: Band theory of solids and energy band diagrams, Carrier statistics and semiconductor behavior; Optical Materials, Band structure engineering and optical properties, Photonic crystals and metamaterials

Wave Optics and Optical Systems [05]
Reflection, Refraction, and Matrix Methods: optical systems, Lenses, Imaging; Aberrations: Lensmaker's equation and thin lens approximation, Optical imaging systems: magnification, resolution, Aberrations and their correction techniques

Advanced Optical Phenomena and Techniques [10] Linear Systems and Transforms in Optics: Fourier optics and spatial frequency domain, Transfer functions and modulation transfer functions, Optical filtering and image processing techniques; Diffraction and Gaussian Beams: Gaussian beam propagation and beam quality parameters, Applications of diffraction in optics

Optical Communication and Sensing [10]
Guided Waves and Fiber Optics: Basics of waveguides and modes, Fiber optic principles and classifications, Fiber optic communication systems and components; Interferometry and Sensing Applications: Principles of interference and coherence, Interferometric sensors: fiber gyroscopes, pressure/temperature/flow sensors

Advanced Optical Technologies and Applications [12] Light Sources, Detectors, and Modulators: Light-emitting diodes (LEDs) and semiconductor lasers, Photodetectors: photodiodes, photomultipliers; Optical modulators: electro-optic and acousto-optic devices; Holography and Optical Signal/Image Processing: Principles of holography and holographic imaging, Digital image processing techniques in optics, Applications in 3D imaging, security, and data storage; High-power laser applications: welding, cutting, additive manufacturing, Emerging trends and future directions in optical engineering

Texts/References

1. Introduction to Electrodynamics, D. J. Griffith, Prentice Hall India (2009)
2. Introduction to Fourier Optics, Joseph W. Goodman, Roberts & Company Publishers; 3rd edition (22 April 2016)
3. An introduction to fiber optics, A.K. Ghatak, Cambridge University Press (1998)
4. Optical Engineering Fundamentals, Bruce H. Walker, McGraw-Hill Education (2010)
5. Field Guide to Optical Fiber Technology, Raman Kashyap, SPIE Press (2010)

MICROWAVE AND RADAR ENGINEERING		Course Code: EC320	Credits:4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Propagation through Waveguides and Microwave Cavity Resonators
Propagation Through WaveGuides: Rectangular and circular waveguides solution of wave equation for TE & TM modes, degenerate and dominant modes, power transmission power loss, excitation of wave guides, nonexistence of TEM mode in waveguide, Introduction to strip line and micro strip-line.
Microwave Cavity Resonators: Rectangular and cylindrical cavities, quality factor and excitation of cavities.

Unit II: Microwave Components
Scattering matrix, E-plane, H-plane and hybrid tees, hybrid ring, waveguide discontinuities, waveguide couplings, bends and twists, transitions, directional couplers, matched load, attenuators and phase shifters, irises and tuning screws, detectors, wave meter, isolators and circulators.

Unit III: Microwave Measurements
Tunable detector, slotted line carriage, VSWR meter, measurement of frequency, wave length, VSWR, impedance, attenuation low and high power radiation patterns.

Unit IV: Microwave Tubes and Microwave Semiconductor Devices
Microwave Tubes: Limitation of conventional active devices at microwave frequency. Klystron, Reflex klystron, magnetron, TWT, BWO: principle of operation and its performance characteristic and application.
Microwave Semiconductor Devices: PIN diode, Tunnel diode, Gunn devices, IMPATT and TRAPATT, their principal of operation, characteristics and applications.

Unit V: Principles of Radar
Radar block diagram operation, radar range equation, radar frequencies, pulse and CW radar, introduction to Doppler and MTI radar, and applications, block diagram of radar receiver for CW and pulse radar, radar displays, introduction to radar clutter.

Text Books:
[1] Liao, Microwave Devices & Circuits, PHI.
[2] A. K Gautam, Microwave and Radar Engineering, Kataria & Sons.

Reference Books:
[3] M.I. Skolnik, Introduction to Radar Engineering, THM.
[4] Collin, R.E. Foundations for Microwave Engineering, TMH.
[5] Rizzi, Microwave Engineering: Passive Circuits, PHI.
[6] A. Das and S.K. Das, Microwave Engineering, TMH.

DIGITAL SIGNAL PROCESSING AND APPLICATIONS		Course Code: EC322	Credits: 4
No. of Lectures (Hrs/Week): 4	**No. of Lectures (Sem.):** 60	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Discrete Fourier Transform
Discrete Fourier transform, frequency domain sampling and reconstruction of discrete-time signals, DFT as a linear transformation, relationship of the DFT to other transforms, properties of the DFT: periodicity, linearity, and symmetry, multiplication of two DFTs and circular convolution, additional DFT properties, frequency analysis of signals using DFT, introduction to MATLAB. (Coding of Implementation of LTI using DFT)

Unit II: Efficient Computation of DFT and Filter Structures
Efficient Computation of DFT: FFT algorithms, direct computation of the DFT, Radix-2 FFT algorithms, efficient computation of the DFT of two real sequences, computations, efficient computation of the DFT of 2N-point real sequences. (Coding of FFT algorithms)
Filter Structures: Direct form (I & II), LATTICE for FIR & IIR filters.

Unit III: Design of FIR Filters
Properties of non-recursive filters, rectangular, Hamming, Blackman, Chebyshev, and Kaiser Windowing, optimum approximation of FIR filters, multistage approach to sampling rate concession. (Coding of windowing for FIR filters)

Unit IV: Design of IIR Filters
Impulse invariant and bilinear transformation techniques for Butterworth and Chebyshev filters; cascade and parallel.
(Coding of Butterworth and Chebyshev filters)

Unit V: Application of DSP and Coding
Sampling frequency conversion, quadrature-mirror-image filter banks, Hilbert transforms, Adaptive digital filters, two dimensional filter designs, Audio and Video coding, MPEG coding standardization, DCT, Walsh and Hardmard Coding.
DSP PROCESSOR ARCHITECTURE FUNDAMENTALS: Study of ADSP and TMS series of processor architectures.

Text Books:

[1] Proakis, J.G. & Manolakis, D.G., Digital Signal Processing: Principles Algorithms and Applications, Prentice Hall.
[2] Apte, Digital Signal Processing, John Wiley.

Reference Books:

[3] Rabiner, L.R. & Gold B., Theory and Applications of DSP, PHI.
[4] Thomas J & Cavichhhi, Digital Signal Processing, John Wiley & Sons
[5] Andreas Antoniou, Digital Signal Processing, McGraw Hill
[6] A. V Oppenhein, Digital Signal Processing, PHI
[7] Ifeachor, Digital Signal Processing, Pearson Education.
[8] Salivahanan, Vallavaraj & Gananpriya, Digital Signal Processing, TMH.

FUNDAMENTALS OF MICROELECTRONICS		Course Code: EC324	Credits: 4
No. of Lectures (Hrs/Week): 4	No. of Lectures (Sem.): 60	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: Fundamentals of Semiconductors
Semiconductor materials, elemental and compound semiconductors, energy band diagram, carrier concentration, drift and diffusion currents, conductivity, Einstein relations, recombination and generation, carrier transport equation.

Unit II: Junction and Interfaces
Description of PN junctions, abrupt, linearly graded, diffused junctions, Diode models, temperature dependence of I-V characteristics, high level injection effects, breakdown mechanism in PN junctions, small signal and switching transients in diodes, LED, varactor, photodiode, Schottkey, tunnel diodes and their constructions and characteristics.

Unit III: Bipolar Junction Transistors
Principle of operation, doping profiles, analysis of ideal diffusion BJT static I-V characteristics, charge control equations, drift, power and switching transistors.

Unit IV: MOSFETS
C-V characteristics of a MOS capacitor, basic structure and operating principle of MOSFETs, I-V characteristics, short channel effects.

Unit V: Advance Semiconductor Devices
Structure, operation and I-V characteristics and high frequency performance of MESFET, fundamentals and applications of hetero-junctions, HEMTs.

Text Books:

[1] S M Sze, Physics of Semiconductor devices, Wiley
[2] M S Tyagi, Introduction to Semiconductor materials and devices, Wiley

Reference Books:

[3] Michael Shur, Physics of Semiconductor devices, PHI
[4] B. G. Streetman and S. Banerjee, Solid state electronics devices, PHI
[5] Donald A. Neamon, Microelectronics, TMH
[6] S.K. Ghandhi, The Theory and Practice of Microelectronics, John Wiley & Sons.

DATA COMMUNICATION NETWORK		Course Code :EC326	Credits: 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction of Physical Layer
Introduction: Switching systems**,** network hardware and software, layering, design issues for layering, reference models and their comparison, example networks.
Physical Layer: Transmission media and channel impairments, modulation, multiplexing, digital channels, mobile telephone systems.

Unit II: Data Link Layer and Medium Access Control
Data Link Layer: Design issues, framing, error control, elementary data link protocols and sliding window protocols, HDLC, data link layer in internet.
Medium Access Control: Channel allocation problem, MAC protocols- Aloha, CSMA, collision free protocols, limited contention protocol, Ethernet, IEEE 802.3 standard, repeaters, bridges, routers and gateways.

Unit III: Network Layer
Design issues, VC and datagram subnets, routing algorithms for wired and wireless hosts, congestion prevention policies, load shedding. Connectivity of networks, connectionless internetworking, internetwork routing, fragmentation, IP protocols, IP addressing, OSPF, IPv6.

Unit IV: Transport Layer
Transport service and primitives, addressing, connation establishment and release, flow control, buffering, multiplexing and crash recovery, introduction of UDP, modeling TCP connection management, TCP congestion control, and performance issues.

Unit V:
DNS name space and DNS server, overview of www, http. Introduction of cryptography, substitution cipher and transposition cipher, DES, cipher methods, public key algorithms, social issues- privacy, freedom of speech, copy right.

Text Books:
[1] Forouzan B.A., Data Communication and Networking, Tata McGraw-Hill.
[2] Tanenbaum A.S, Computer Networks, Pearson Education.

Reference Books:
[3] Stallings W., Data and Computer Communication, Prentice-Hall.
[4] Kurose J.F. & Ross K.W., Computer Networking: A Top-Down Approach Featuring the Internet, Addison Wesley.

IC FABRICATION TECHNOLOGY		Course Code:EC328	Credits:3
No. of Lectures (Hrs/Week): 3	No. of Lectures (Sem.): 45	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: Introduction to IC Technology, Crystal Growth and Oxidation
Introduction to IC Technology: Classification if ICs, Scale of integration, semiconductor and hybrid ICs Features of ICs. **Crystal Growth:** monolithic and hybrid ICs, crystal growth**,** techniques of crystal growth (Czochloskey and Bridgeman), wafer preparation and specifications, testing, measurements of parameters of crystals, Fabrication steps. **Oxidation:** Theory of growth of Silicon di-oxide layer, calculation of SiO2 thickness and oxidation kinetics, Dry wet and high pressure oxidation, plasma oxidation, properties of oxidation, defects induced due to oxidation.

UNIT II: Epitaxial Process and Diffusion Process
Epitaxial Process: Epitaxy and its concept, Growth kinetics of epitaxy, epitaxial growth, Low temperature epitaxy, Si-epitaxy-growth chemistry of Si epitaxial layer, auto doping apparatus for epitaxial layer, apparatus for epitaxy, MBE system
Diffusion Process: Diffusion models of solid, Ficks theory of diffusion, Solution of Fick`s law, diffusion parameters measurements schemes, Ion implantation- Scattering phenomenon, range theory, channeling, implantation damage, ion-implantation systems, Annealing.

UNIT III: Lithography and Photo resist and Etching
Lithography: Photolithography and pattern transfer, Optical and non-optical lithography, electron, X-ray and ion-beam lithography, contact/proximity and projection printers, alignment.
Photo Resist and Etching: Types of photo resist, polymer and materials, Etching**-** Dry & Wet etching, basic regimes of plasma etching, reactive ion etching and its damages, lift-off, and sputter etching.

UNIT IV: Metallization and IC Process Integration
Metallization: Applications and choices, physical vapor deposition, patterning, problem areas.
IC Process Integration: PMOS**,** NMOS and CMOS IC technology, MOS memory IC technology, bipolar IC fabrication.

UNIT 5: Assembly Technique and Packaging, and Yield and Reliability
Assembly Technique and Packaging: Package types, packaging design consideration, IC assembly technologies.
Yield and Reliability: Yield loss in IC, yield loss modeling, reliability requirements, accelerated testing.

Text Books:
[1] S. M. Sze, VLSI Technology, McGraw Hill.
[2] S. A. Campbell, The Science and Engineering of Microelectronic Fabrication, Oxford University Press.

Reference Books:
[3] Adel S. Sedra & Kenneth C. Smith, Microelectronic Circuits, International Student Edition, Oxford University Press.
[4] Richard C. Jaegar, Introduction to Microelectronic Fabrication, Prentice Hall.
[5] S. K. Ghandhi, VLSI Fabrication Principles, John Wiley & Sons.
[6] Runyan & Bean, Semiconductor Integrated Circuit Processing Technology, Adison-Wesley Inc.
[7] R. A. Colclaser, Microelectronics - Processing and Device Design, John Wiley & Sons.

III-YEAR (VI-SEMESTER)

MICROWAVE ENGINEERING LAB		**Course Code:** EC372	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. Verification of the characteristics of the reflex klystron tube and determine its electronic tuning range.
2. Measurement the frequency and wavelength of a rectangular waveguide working on TE_{10} mode.
3. To determine the standing wave ratio and coefficient of rectangular wave-guide.
4. To verify the following characteristics of Gunn Diode:
5. V-I characteristics.
6. Output power and frequency as a function of voltage.
7. Square wave modulation through PIN diode.
8. To measure the polar pattern and the gain of wave guide horn antenna.
9. Verification of the function of multi- hole directional coupler using the following parameters.
10. Main line and auxiliary line VSWR.
11. Coupling factor & directivity of the coupler.
12. Determine S-parameters of magic Tee terminated by matched load.
13. Verify working principal of the Isolator.
14. Verify working principal of the Circulators.
15. Verify working principal of Attenuators (Fixed and variable type).
16. Verify working principal of the Phase shifter.

DIGITAL SIGNAL PROCESSING AND APPLICATIONS LAB		Course Code: EC374	Credits: 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

Note: From experiment 14 onwards, lab will be performed by using Simulation Software MATLAB.

1. To verify Linear Convolution
2. To verify Circular Convolution
3. To verify Discrete Fourier Transform.
4. To verify Fast Fourier Transform.
5. To verify FIR low pass filter using Rectangular window.
6. To verify FIR low pass filter using Hamming window.
7. To verify FIR low pass filter using Triangular window.
8. To verify FIR high pass filter using Rectangular window.
9. To verify FIR high pass filter using Hamming window.
10. To verify FIR high pass filter using Triangular window.
11. To verify IIR low pass filter.
12. To verify IIR high pass filter.
13. To verify DCT.
14. To develop elementary signal function modules (m-files) for unit sample, unit step, exponential and unit ramp
15. To develop program modules based on operation on sequences like signal shifting, signal folding, signal addition and signal multiplication.
16. To develop program for discrete convolution and correlation.
17. To develop program for finding response of the LTI system described by the difference equation.
18. To develop program for computing inverse Z-transform.
19. To develop program for finding magnitude and phase response of LTI system described by system function H(z).
20. To develop program for computing DFT and IDFT.
21. To develop program for computing circular convolution.
22. To develop program for conversion of direct form realization to cascade form realization.
23. To develop program for cascade realization of IIR and FIR filters.
24. To develop program for designing FIR filter.
25. To develop program for designing IIR filter.

SIMULATION LAB		Course Code: EC376	Credits: 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

Note: All experiments have to be performed using Simulation Software available.

1. RC Phase-Shift Oscillator
2. Wein Bridge Oscillator
3. Current Series Feedback Amplifier
4. Differential Amplifier
5. Cascode Amplifier
6. Class-B Power Amplifier
7. Op-Amp Configuration
8. Two Stage RC Coupled Amplifier.
9. Differential Amplifier.
10. RC Phase-Shift Oscillator
11. Power Amplifier.
12. Different Configuration of Op-Amp.

Elective-2

III-YEAR (VI-SEMESTER)
(ELECTIVE-2)

SECURE COMMUNICATION		**Course Code:** EC340	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Direct Sequence Spread Spectrum Systems
Model of SS digital communication system, direct sequence spread spectrum signal, error rate performance of the decoder, processing gain and jamming margin, uncoded DSSS signals, applications of DSSS signals in anti-jamming, low detectability signal transmission, code division multiple access and multipath channels, effect of pulsed interference on DSSS systems, Generation of PN sequences using m sequence and Gold sequences, excision of narrowband interference in DSSS systems, acquisition and tracking of DSSS system.

Unit II: Frequency Hopped Spread Spectrum Systems
Basic concepts, slow and fast frequency hopping, performance of FHSS in AW GN and partial band interference, FHSS in CDMA system, Time hopping and hybrid SS system, acquisition and tracking of FH SS systems.

Unit III: Cryptographic Techniques
Classical encryption technique, Symmetric cipher model, cryptography and cryptanalysts, Substitution techniques, transposition techniques

Unit IV: Block Cipher and Data Encryption Standard
Block cipher principle, data encryption standard (DES) strength of DES, differential and linear cryptanalysts, block cipher design principles, simplified advanced encryption standard (S-AES), multiple encryption and triple DES, Block cipher modes of operation, stream ciphers and RC4 algorithm

Unit V: Public Key Cryptography
Prime numbers, Fermat and Euler’s theorem, Chinese remainder theorem, discrete algorithms, principles of public key crypto systems, RSA algorithm, key management Diffie-Hellman key exchange, message authentication requirements and functions.

Text Books:
[1] J.G. Proakis, Digital Communication, McGraw Hill.
[2] W. Stallivgs, Cryptography and Network Security, PHI.

Reference Books:
[3] Simon Haykin, Digital Communication, Wiley.
[4] Taub & Schilling, Principle of Communication systems, TMH.
[5] M.Y. Rhee, Cryptography and secure Communications, Mc Graw Hill.

III-YEAR
(ELECTIVE-2)

RF ENGINEERING		**Course Code:** EC342	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction
Review of Transmission line Theory, terminated transmission lines, smith chart, impedance matching, Microstrip and Coplanar waveguide implementations, microwave network analysis, ABCD parameters, S-parameters, X parameters.

Unit II: Transmission Line based Components
Behavior of passive components and networks, resonant structures using distributed transmission lines, power dividers, couplers and filters; CRLH transmission line based components.

Unit III: RF Antennas
Introduction to planar microwave antennas, definitions and basic principles, Smart antennas; Link plan and propagation studies

Unit IV: RF Circuit Design
Basics of high frequency amplifier design, biasing techniques, simultaneous tuning of 2 port circuits, noise and distortion, linearity, noise and large signal performance, Power amplifier design, Low Noise amplifier design.

Unit V: RF MEMS System
MEMS technologies and components for RF applications: RF MEMS: switches, varactors, inductors, filters, phase shifters, resonators, oscillators, Antennas, Power Amplifiers, LNA,

Text Books:

[1] D. M Pozar, Microwave and RF Wireless Systems, Wiley.
[2] T H Lee, The Design of CMOS Radio Frequency Integrated Circuits, Cambridge University Press.

Reference Books:
[3] V. K Varadan, K.J. Vinoy, K.A. Jose, RF MEMS and Their Applications, Wiley.

III-YEAR
(ELECTIVE-3)

BROADBAND NETWORKS		**Course Code:** EC344	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction
Introduction to broadband wireless, fixed broadband wireless, mobile broadband wireless, 3G cellular systems, spectrum options for BW, BW channels, fading, modeling of broadband fading channels, mitigation of fading

Unit II: OFDM
OFDM-basics, timing and frequency synchronization, PAR computational complexity, simulation of OFDM systems, , MAC layer, performance enhancement, architecture, performance characterization, Multiple antenna techniques-spatial diversity, receiver diversity, transmit diversity, beam foaming, spatial multiplexing, channel estimation for MIMO-OFDM, advanced techniques for MIMO,OFDMA in WiMAX

Unit III:
WiMAX, Physical layer- channel coding, hybrid ARQ, interleaving, symbol mapping, symbol structure, sub channel and subcarrier permutations, slot and frame structure, ranging power control, channel quality measurements, MAC layer-convergence SL, MAC PDU, bandwidth request, and allocation, QoS, network entry, an initialization, power saving, mobility management.

Unit IV:
WiMAX network architecture- design principle, reference model, protocol layering, network discovery and selection, IP address assignment, authentication and security, QoS architecture, mobility management, radio resource management, link level performance-methodology, AWGN channel performance, fading channel performance, advanced receiver architecture, system level architecture-channel modeling, methodology, system level simulation.

Unit V: Ultrawideband, Unlicensed wireless access, IEEE 802.20 MBWA, FOMA, iMODE, WiBRO, FWA, AWS, Multimedia-MedaiFLO, T-DBM, DVB-H, MVNO

Text Books:

[1] Jeffrey G. Andrews, Arunabha Ghosh, Rias Muhamed, Fundamentals of WiMAX, Understanding Broadband Wireless Networking, Pearson
[2] Clint Smith, P.E. Daniel Collins, 3G Wireless Networks, TMH.

IV-YEAR
(ELECTIVE-3)

RELIABILITY ENGINEERING		**Course Code:** EC346	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction to Reliability Engineering
Types of systems, Reliability definitions and concepts, Failures, Bathtub curve, Reliability evaluation techniques, Reliability activities in system design, Reliability data, Reliability monitoring and growth. Challenges and future needs for the practices of reliability.

Unit II: Basic Reliability Mathematics
Classical set theory and Boolean algebra, Concepts of probability theory, Distributions used in reliability, Failure data analysis, MTTF, MTTR, MTBF.

Unit III: System Reliability Modeling
Reliability block diagram (RBD), Markov models, Fault tree analysis, and Event tree analysis.

Unit IV: Electronic System Reliability
Importance of electronic industry, various components used and their Failure mechanisms, Reliability prediction of electronic systems, PRISM, Sneak circuit analysis, Physics of failure mechanisms of electronic components.

Unit V: Network Reliability Analysis: Network model, Network operations, parallel computing and networks, Network design considerations, Classification of interconnection networks, Approaches for calculating network reliability.

Text Books:
[1] Roy Billinton, Ronald N. Allan, Reliability Evaluation of Engineering Systems: Concepts and Techniques, Springer.
[2] Ajit Kumar Verma, Srividya Ajit, Durga Rao Karanki, Reliability and Safety Engineering, Springer.

Reference Book:
[3] Indra Gunawan, Fundamental of Reliability Engineering, Wiley
[4] Misra K. B., Reliability Analysis and Prediction, A Methodology Oriented Treatment, Elsevier Publication
[5] Kapur K. C. and L. R. Lamberson, Reliability in Engineering Design, John Wiley & Sons,
[6] Martin L Shooman, Reliability of Computer Systems and Networks, John Wiley Sons

IV-YEAR
(ELECTIVE-2)

PHYTHON PROGRAMMING		Course Code: CS340	Credits: 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

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

UNIT II Conditional statement
Conditional statement in Python (if-else statement, its working and execution), Nested-if statement and Elif statement in Python, Expression Evaluation & Float Representation. Loops: Purpose and working of loops , While loop including its working, For Loop , Nested Loops , Break and Continue.

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

UNIT IV Sieve of Eratosthenes
generate prime numbers with the help of an algorithm given by the Greek Mathematician named Eratosthenes, whose algorithm is known as Sieve of Eratosthenes. File I/O : File input and output operations in Python Programming Exceptions and Assertions Modules : Introduction , Importing Modules , Abstract Data Types : Abstract data types and ADT interface in Python Programming.Classes Class definition and other operations in the classes , Special Methods (such as _init_, _str_, comparison methods and Arithmetic methods etc.) , Class Example , Inheritance , Inheritance and OOP.

UNIT V Recursion:
Recursive Fibonacci , Tower Of Hanoi Search : Simple Search and Estimating Search Time , Binary Search and Estimating Binary Search Time Sorting & Merging: Selection Sort , Merge List , Merge Sort , Higher Order Sort

Text Books:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist‘‘,2nd edition, Updated for Python Shroff/O‘Reilly Publishers, 2016 (http://greenteapress.com/wp/thinkpython/)
2. Guido van Rossum and Fred L. Drake Jr, ―An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.
3. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

IV-YEAR
(VII-SEMESTER)

V-YEAR (VIII-SEMESTER)

WIRELESS COMMUNICATION		**Course Code:** EC421	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Service and Technical Challenges
Types of services, requirements for the services, multipath propagation, spectrum limitations, noise and interference limited systems, principles of cellular networks, multiple access schemes.

Unit II: Wireless Propagation Channels
Propagation mechanisms (qualitative treatment), propagation effects with mobile radio, channel classification, link calculations, narrowband and wideband models, propagation models, path loss components.

Unit III: Wireless Transceivers
Structure of a wireless communication link, modulation and demodulation–quadrature/4-differential quadrature phase shift keying, offset- quadrature phase shift keying, phase shift keying, binary frequency shift keying, minimum shift keying, Gaussian minimum shift keying, power spectrum and error performance in fading channels.

Unit IV: Signal Processing in Wireless Systems
Principle of diversity, macro-diversity, micro-diversity, signal combining techniques, transmit diversity, equalizers- linear and decision feedback equalizers, review of channel coding and speech coding techniques.

Unit V: Advanced Transceiver Schemes
Spread spectrum systems- cellular code division multiple access systems- principle, power control, effects of multipath propagation on code division multiple access, application of orthogonal frequency division multiplexing in GSM, IS–95, IS-2000 and III & IV generation wireless networks and standards.

Text Books:

[1] Andreas.F. Molisch, Wireless Communications, John Wiley – India.
[2] Simon Haykin & Michael Moher, Modern Wireless Communications, Pearson Education.

Reference Books:

[3] Rappaport. T.S., Wireless communications, Pearson Education.
[4] Gordon L. Stuber, Principles of Mobile Communication, Springer International Ltd.
[5] Andrea Goldsmith, Wireless Communications, Cambridge University Press.

FIBER OPTIC COMMUNICATION		**Course Code:** EC423	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction

Forms of communication system, evolution of fiber optic system, elements of a fiber transmission link, advantages of optical fiber communication

UNIT II: Optical Fibers

The nature of light, basic optical Laws, fiber types, electromagnetic theory of propagation of light in optical fibers, waveguide equations for step index fibers, modes in step index fiber, power flow in the step index fibers, graded index fiber, modes in graded index fiber. Fiber fabrication: outside vapor phase oxidation, vapor phase axial deposition, modified chemical vapor deposition, double crucible method, and mechanical properties of fibers. Signal degradation in optical fibers: absorption, scattering losses, bending loss, material dispersion, waveguide dispersion, intermodal distortion, pulse broadening in graded index waveguides. Fiber to fiber joints, fiber end face preparation. Fiber splicing: splicing techniques, optical fiber connectors.

Unit III: Optical Sources

Types of optical sources, Lasers: basic concepts, absorption and emission of radiation, population inversion, optical feedback and laser oscillation, p-n junction, spontaneous emission, stimulated emission and lasing, laser modes, single mode operation, non-semiconductor laser, Light emitting diodes: the double heterojunction LED, Planner LED, surface emitter LEDs, edge emitter LEDs, LED characteristics, optical output power, output spectrum, modulation bandwidth, reliability.

Unit IV: Detectors and Amplifiers

Device type, optical detection principles, absorption, quantum efficiency, responsivity, long wavelength cutoff, semiconductor photodiodes without internal gain, photodiodes with internal gain, phototransistors, photoconductive detectors, Optical amplifiers: semiconductor amplifiers, fiber amplifiers

Unit V: Advanced Systems And Applications

Wavelength Division Multiplexing, local area networks, photonic switching, nonlinear optical effects. Public network applications: trunk network, junction network, local access network, synchronous networks, military applications, optical sensor systems, computer applications

Text Books:

[1] Senior J M, Optical Communication Principle and Practices, Pearson Education Ltd.
[2] Keiser G, Optical Fiber Communications, McGraw Hill.

Reference Books:

[3] Biswas Sambhu Nath, Optoelectronic Engineering, Dhanpat Rai Publication.
[4] Gowar J., Optical Communication Systems, PHI.

VLSI DESIGN		**Course Code:** 425	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Review
Current conduction in MOSFET, electrical properties of MOS, CMOS, BiCMOS, pass transistor.

Unit II: CMOS Inverter and Combinational Logic
CMOS Inverter: Static CMOS inverter, layout, switching threshold and noise margin concepts and their evaluation, dynamic behavior, power consumption. NMOS MOS pass transistor inverter.
Combinational Logic: Static CMOS design, rationed logic, pass transistor logic, dynamic logic, cascading dynamic gates, CMOS transmission gate logic.

Unit III: Sequential Logic
Static latches and registers, bi-stability principle, MUX based latches, static SR flip-flops, master-slave edge-triggered register, dynamic latches and registers, concept of pipelining, timing issues.

Unit IV: Memory and Array Structure
ROM, RAM, peripheral circuitry, memory reliability and yield, SRAM and DRAM design, flash memory, PLA, PAL, FPGA.

Unit V: Design for Testability
Logic testing, sequential logic testing, guidelines to be adopted in design for test, scan designing techniques, built-in self-test (BIST) techniques.

Text Books:
[1] D.A. Pucknell & Eshraghian, Basic VLSI Design, PHI
[2] Wayne Wolf, Modern VLSI Design Systems on Silicon, Pearson Publication

Reference Books:
[3] R. K. Singh, VLSI Design (With VHDL), Kataria & Sons.
[4] S M Kunj and L. Yusuf, CMOS Digital Integrated Circuits, McGraw Hill.
[5] S M Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall.

FIBER OPTIC COMMUNICATION LAB		**Course Code:** EC471	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

1. Demonstration and study of different types of Optical Fibers and connectors.
2. To establish and Study of a 650nm fiber optic analog link.
3. To establish and Study of a 650nm fiber optic digital link.
4. Setting up Fiber Optic Analog/Digital link.
5. Study of Pulse Amplitude Modulation (PAM) and Demodulation.
6. Study of 4 Channel Time Divisions Multiplexing and De-multiplexing.
7. Study of Amplitude Modulation and Demodulation.
8. Measurement of length of fiber cable.
9. Study of Intensity Modulation Technique using Analog input signal
10. To measure propagation or attenuation loss in optical fiber.
11. To measurement of the Numerical Aperture (NA) of the fiber.
12. Measurement of coupling and bending losses in Optical fiber.
13. Set up of time division multiplexing using fiber optics.
14. Measurement of bending loss and connector loss.
15. Study of characteristics of Fiber Optic LEDs and Detectors.
16. Forming simple Fiber Optic voice link using MIC & Speaker.
17. Effect of Switch Faults.
18. Study of Pulse Width Modulation (PWM) and Pulse Position Modulation (PPM).
19. Forming PC to PC communication link using Optic Fiber link.

IV-YEAR (VII-SEMESTER)

VLSI DESIGN LAB		**Course Code:** EC473	**Credits:** 1
No. of Lab (Hrs/Week): 2	**No. of Lab Sessions (Sem.):** 10	**Mid Sem. Exam (Hrs):** 0	**End Sem. Exam (Hrs):** 2

Suggested list of Experiments, but not limited to:

Note: Experiments of this lab will be based on Implementation & Design using Simulation Softwares.

1. Realization of Gates using Verilog (AND, OR, NOT)
2. Realization of Universal Gates using Verilog (NAND, NOR, EX-OR, EX-NOR).
3. Realization of 2 to 4 Decoder using Verilog.
4. Realization of 3 to 8 Encoder using Verilog.
5. Realization of Combinational Design of Multiplexer using Verilog.
6. Realization of Combinational Design of Demultiplexer and Comparator using Verilog.
7. Realization of Functions of Half and Full Adder with different Modeling style using Verilog.
8. Realization of 32 bit ALU using Verilog.
9. Realization of Flip-flops using Verilog (SR, D, JK, T).
10. Realization of a 4-bit binary, BCD counters and any sequence counter with Synchronous Reset.
11. Realization of a 4-bit binary, BCD counters and any sequence counter with Asynchronous Reset.
12. Realization of Verilog code for 7- Segments Display.
13. Realization of Verilog codes to display messages on given LCD panel.
14. Realization of Verilog code to operate a given stepper motor.

ELECTIVE-3

IV-YEAR
(ELECTIVE-3)

ELECTRONICS SWITCHING SYSTEM		**Course Code:** EC441	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Introduction
Message switching, circuits switching, functions of a switching system, register translator senders, distribution frames, crossbar switch, a general trunking Transmission Systems, FDM Multiplexing and modulation, Time Division Multiplexing, Digital Transmission and Multiplexing: Pulse Transmission, Line Coding, Binary N-Zero Substitution, Digital Bi-phase, Differential Encoding, Time Division Multiplexing (T1 carrier system CCIT and DS lines) Time Division Multiplex Loops and Rings.

Unit II: Digital Switching
Switching functions, space division switching, multiple stage switching, non blocking switches, blocking Probabilities DCS hierarchy, integrated cross connect equipment, digital switching in environment, zero loss switching.

Unit III: Telecom Traffic Engineering
Network traffic load and parameters, grade of service and blocking probability, Traffic Characterization: Arrival Distributions, Holding Time Distributions, Loss Systems, Network Blocking Probabilities: End-to-End Blocking Probabilities, Overflow Traffic, Delay Systems: Exponential service Times, Constant Service Times, Finite Queues.

Unit IV: Network Synchronization Control and Management
Timing Recovery, Phase-Locked Loop, Clock Instability, Jitter Measurements, Systematic Jitter. Timing Inaccuracies: Slips, Asynchronous Multiplexing, Network Synchronization, U.S. Network Synchronization, Network Control, Network Management.

Unit V: Digital Subscriber Access, Digital Loop CarrierI Systems and DSL Technology
Digital Subscriber Access: ISDN Basic Rate Access Architecture, ISDN U Interface, ISDN D Channel Protocol. HD-Rate Digital Subscriber Loops: Asymmetric Digital Subscriber Line, VDSL.
Digital Loop CarrierI Systems: Universal Digital Loop Carrier Systems, Integrated Digital Loop Carrier Systems, Next-Generation Digital Loop Carrier, Fiber in the Loop, Hybrid Fiber Coax Systems, Voice band Modems: PCM Modems, Local Microwave Distribution Service, Digital Satellite Services.
DSL Technology: ADSL, Cable Modem, Traditional Cable Networks, HFC Networks, Sharing, CM & CMTS and DOCSIS. SONET: Devices, Frame, Frame Transmission, Synchronous Transport Signals, STSI, Virtual Tributaries and Higher rate of service.

Text Books:
[1] Thyagarajan Viswanath, Tele Communication Switching System and Networks, PHI.
[2] J. Bellamy, Digital Telephony, John Wiley.

Reference Books:
[3] Achyut. S.Godbole, Data Communications & Networks, TMH.
[4] H. Taub & D. Schilling , Principles of Communication Systems, TMH.

IV-YEAR
(ELECTIVE-3)

INTRODUCTION TO ROBOTICS		Course Code: EC443	Credits: 3
No. of Lectures (Hrs/Week): 3	No. of Lectures (Sem.): 45	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

UNIT I THE KINEMATICS OF ROBOTICS

Forward and inverse kinematics, motion kinematics, low-level and high-level trajectory planning. static force and torque relations, internal sensory devices: position and velocity sensors, external sensory devices: force, tactile and proximity sensors, machine vision, robot programming: multi-level approach, programming techniques, world modeling, off-line programming and simulation.

UNIT II BASIC ROBOT FUNCTIONING

History of robots, types of robots, uses of robots, present status and future trends in robotics, overview of robot subsystems, Issues in designing and controlling robots: resolution, repeatability and accuracy, transmission, Robot configurations and concept of workspace, mechanisms and transmission, motion planning obstacle avoidance, configuration space, road map methods, graph search algorithms, potential field methods.

UNIT III SPATIAL DESCRIPTIONS

Descriptions, postings, orientations, and frames, mappings, operators: translations, rotations, and transformations, transformation arithmetic, transform equations, transformation of free vectors, computational considerations.

UNIT IV ROBOT ANATOMY

End effectors and actuators, Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electric actuators, Sensors and controllers, internal and external sensors, position, velocity and acceleration sensors, proximity sensors, force sensors, laser range finder, camera, micro-controllers, centralized controllers, real time operating systems.

UNIT V TASK SPECIFICATION OF ROBOT

Point to point and continuous motion specifications for typical applications, joint interpolation, task space interpolation, executing user specified tasks, Robot analysis, position and orientation of rigid bodies, spatial mechanism description, Denavit-Hartenberg notation, homogenous transformation, forward and inverse position analysis, velocity mapping, static force analysis, singularities, acceleration mapping, robot control Independent joint control, PD and PID feedback, actuator models, nonlinearity of manipulator models, issues in nonlinear control, force feedback, hybrid control, Case studies: Robot in assembly (Puma). Mobile robot (Nataraj)

Text Books:

1. Introduction to Robotics, Mechanics and control, John J. Craig, Pearson Education publication, 2004.
2. Robotic moments, S Mujtaba and R. Goldman, PHI publication, 2003.
3. An Advance Robotic Programming, A. Gilbert, American Robot Corporation.
4. Design of an Interactive Manipulator Programming environment, UMI Research Press.
5. Mechanical Engineering design, J Shigley, 3rd edition, Mc, Graw hill, New York.

IV-YEAR
(ELECTIVE-3)

TELEVISION ENGINEERING		**Course Code:** EC445	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Fundamental of Television
Geometry form and Aspect Ratio, Image Continuity, Number of scanning lines, interlaced scanning, Picture resolution, composite video signal, video signal dimension, horizontal sync, vertical sync, Picture signal Transmission, positive and negative modulation, VSB transmission, sound signal transmission, channel bandwidth, TV standards.

Unit II: Camera and Picture Tubes
Basic principle of camera tubes, Image orthicon, vidicon, plumbicon, silicon diode array vidicon, solid state image scanners, monochrome picture tubes, beam deflection, screen phosphor, face plate, picture tube characteristics.

Unit III: Monochrome Television
TV transmitter, TV signal propagation, Interference, TV transmission Antennas, Monochrome TV receiver, RF tuner, UHF, VHF tuner, Digital tuning techniques, AFT-IF subsystems, AGC, Noise cancellation, Video and sound inter carrier detection, vision IF subsystem, video amplifiers requirements and configurations, DC reinsertion, Video amplifier circuits, Sync separation, typical sync processing circuits, Deflection current waveform, Deflection Oscillators, Frame deflection circuits, requirements, Line Deflection circuits, EHT generation, Receiver Antennas.

Unit IV: Color Television
Compatibility, color perception, Three colour theory, luminance, hue and saturation, color television cameras values of luminance and color difference signals, colour signal transmission bandwidth, modulation of color difference signals, weighting factors, Formation of chrominance signal. Introduction to different color television systems: NTSC color TV system, PAL color TV SECAM system. PAL colour TV receiver, color television display tubes, delta, gun-precision, in-line and Trinitron color picture tubes.

Unit V: Advance Television Systems
Satellite TV technology, Cable TV, VCR- Video Disc recording and playback, Tele Text broadcast receiver, digital television, Transmission and reception, projection Television, Flat panel display TV receiver, Stereo-sound in TV, 3D TV, HDTV, LCD, LED Television.

Text Books:
[1] R. R. Gulati, Monochrome Television Practice, Principles, Technology and Servicing, New Age International Publishers.
[2] R. R. Gulati, Monochrome and Colour Television , New Age International Publisher.

Reference Books:
[3] A. M Dhake, Television and Video Engineering, TMH.
[4] S. P. Bali, Colour Television, Theory and Practice, TMH.

IV-YEAR
(ELECTIVE-3)

FUNDAMENTALS OF INTERNET OF THINGS		**Course Code:** EC447	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

UNIT I: INTRODUCTION TO IOT

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and OT, IoT Challenges, Drivers Behind New Network Architectures: Scale, Security, Constrained Devices and Networks, Data, Legacy Device Support .

UNIT II: IOT NETWORK ARCHITECTURE AND DESIGN

Comparing IoT Architectures: The one M2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture, Additional IoT Reference Models, A Simplified IoT Architecture, The Core IoT Functional Stack- Layer 1: Things: Sensors and Actuators Layer, Layer 2: Communications Network Layer, Layer 3: Applications and Analytics Layer, IoT Data Management and Compute Stack: Fog Computing, Edge Computing, The Hierarchy of Edge, Fog, and Cloud.

UNIT III: NETWORK AND APPLICATION PROTOCOLS FOR IOT

Wireless Communication Technologies: ZigBee, ESP8266, Introduction to sensors and modules - concept, layout, working, applications, Introduction of IoT Development Boards-Node MCU, Arduino, IoT Access Technologies 107IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, IEEE 1901.2a, IEEE 802.11ah, LoRaWAN, Constrained Devices, Constrained-Node Networks, Optimizing IP for IoT :From 6LoWPAN to 6Lo, Header Compression, Fragmentation, Mesh Addressing, Mesh-Under Versus Mesh-Over Routing, Authentication and Encryption on Constrained Nodes , Application Protocols for IoT: CoAP, Message Queuing Telemetry Transport (MQTT) .

UNIT IV: DATA ANALYTICS AND SECURITY OF IOT

An Introduction to Data Analytics for IoT, Structured Versus Unstructured Data, Data in Motion Versus Data at Rest, IoT Data Analytics Overview, IoT Data Analytics Challenges, Machine Learning : Machine Learning Overview Supervised Learning, Unsupervised Learning, Neural Networks, Securing IoT : Common Challenges in IoT Security, Device Insecurity, Network Characteristics Impacting Security, Security Priorities: Integrity, Availability, and Confidentiality, Formal Risk Analysis Structures: IAS OCTAVE, Top Vulnerabilities of IoT.

UNIT V: IMPLEMENTING IoT IN REAL LIFE

Interfacing sensors with development boards, communication modules with sensors, communication modules with development boards, MATLAB and Arduino Interfacing, Hands-on in IoT - various real life projects involving different boards, sensors, modules and communication technologies.

Text Books:

1. IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things by Rob Barton, Gonzalo Salgueiro, David Hanes
2. Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1stEdition, VPT, 2014.
3. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, 1st Edition, Apress Publications, 2013

IV-YEAR
(ELECTIVE-3)

SENSOR NETWORKS		**Course Code:** EC449	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Sensor Network Operations
Overview of mission-oriented sensor networks, trends in sensor development, mission oriented sensor networks, dynamic systems perspective, Dense sensor networks, robust sensor positioning in wireless ad hoc sensor networks, trigonometric k clustering (TKC) for censored distance estimation, sensing coverage and breach paths in surveillance wireless sensor networks.

Unit II: Lower Layer Issues-Mac, Scheduling, And Transmission
Medium access control for sensor networks, comprehensive performance study of IEEE 802.15.4, providing energy efficiency for wireless sensor networks, link adaptation techniques.

Unit III: Network Routing
Load balanced query protocols for wireless sensor networks, energy efficient and MAC aware routing for data aggregation in sensor networks, ESS low energy security solution for large-scale sensor networks based on tree ripple zone routing scheme.

Unit IV: Sensor Network Applications
Evader centric program, Pursuer centric program, hybrid pursuer evader program, efficient version of hybrid program, Implementation and simulation results

Unit V: Embedded Soft Sensing For Anomaly Detection
Mobile robot simulation setup, software anomalies in mobile robotic networks, soft sensor, software anomaly detection architecture, anomaly detection mechanisms, test bed for software anomaly detection in mobile robot application, multisensor network-based framework; Basic model of distributed multi sensor surveillance system, super resolution imaging, optical flow computation, super resolution image reconstruction, experimental results.

Text Books:
[1] Shashi Phoha, Thomas F. La Porta , Chrisher Griffin, "Sensor Network Operations", Wiley-IEEE Press March 2006.
[2] Jr. Edger H. Callaway, "Wireless sensor networks", CRC Press.

References:
[1] I. F. Akyildiz and M. C. Vuran, "Wireless Sensor Networks", John Wiley and Sons Publ. Company
[2] Feng Zho, Morgan Kaufmann ,"Wireless Sensor Networks: An Information Processing Approach".

ELECTIVE-4

IV-YEAR
(ELECTIVE-4)

ARTIFICIAL NEURAL NETWORK AND FUZZY LOGIC		Course Code: CS425	Credits: 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Neural Networks-I (Introduction and Architecture)
Neuron, Nerve structure and synapse, Artificial Neuron and its model, activation functions, Neural network architecture: single layer and multilayer feed forward networks, recurrent networks, various learning techniques; perception and convergence rule, Auto-associative and hetro-associative memory.

Unit II: Neural Networks -II (Back Propagation Networks)
Architecture: perceptron model, solution, single layer artificial neural network, multilayer perception model; back propagation learning methods, effect of learning rule co-efficient; back propagation algorithm, factors affecting back propagation training, applications.

Unit III: Fuzzy Logic -I (Introduction)
Basic concepts of fuzzy logic, Fuzzy sets and Crisp sets, Fuzzy set theory versus probability theory, Fuzzy set theory and operations, Properties of fuzzy sets, Fuzzy and Crisp relations, Fuzzy to Crisp conversion.

Unit IV: Fuzzy Logic –II (Fuzzy Membership, Rules)
Membership functions, interference in fuzzy logic, fuzzy if-then rules, Fuzzy implications and Fuzzy algorithms, Fuzzyfications & Defuzzifications, Fuzzy Controller.

Unit V: Application of Neural Network and Fuzzy Logic
Application of neural network, case study, Inverted pendulum, Image processing, introduction to neuro & fuzzy logic controller.

Text Books:

[1] Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing home.
[2] Timothy J. Ross, 'Fuzzy Logic with Engineering Applications, John Wiley.

IV-YEAR
(ELECTIVE-4)

EVOLUTIONARY COMPUTATION		**Course Code:** CS427	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

UNIT I FUNDAMENTAL CONCEPTS AND DIALECTS

Metaheuristics; Requirements of metaheuristics in optimization problems; characteristics of problems suitable for applicability of metaheuristics; Evolutionary computing metaphor and Inspiration from biology; Applications, Pros, and cons of evolutionary computations; Components of evolutionary computation; example applications – eight queen problem, knapsack problem; various dialects of evolutionary computation.

UNIT II GENETIC ALGORITHMS

Introduction; Canonical GA; Binary, integer, real-valued, and permutation representations and variation operators for them; Population Models; Parent Selection – Fitness proportionate selection, Rank based selection, implementing selection probabilities, tournament selection; Survivor strategy. Implementation issues, parameters' control and effect on GA dynamics.

UNIT III THEORETICAL FOUNDATION OF GENETIC ALGORITHMS

Schemas and hyperplane sampling; Schemata theorem, limitations and building block hypothesis; Two-armed bandit problem; Deceiving a GA; Minimal deceptive problem; Royal Roads functions; SAHC; NAHC; RMHC; Hitchhiking; Exact Mathematical Models of SGA; Statistical-Mechanics Approaches.

UNIT IV PROBLEM SOLVING USING EC

Evolving computer programs – evolving LISP programs, evolving cellular automata; Data analysis and prediction – predicting dynamical system, predicting protein structure; Evolving Neural Networks – evolving weights, architecture (Direct encoding and Grammatical encoding), and learning rules; Baldwin effect and evolutionary reinforced learning.

UNIT V PARALLEL IMPLEMENTATION AND OTHER DIALECTS OF EVOLUTIONARY COMPUTATION

Parallel implementation of GA; Genetic Programming; Evolutionary Programming; Evolutionary Strategies; Learning Classifier Systems; Memetic Algorithms; Introduction to MOGA.

Text Books:

1. An Introduction to Genetic Algorithms, Milanie Mitchell, MIT Press.
2. Genetic Algorithms, David E. Goldberg, Pearson Education.
3. Handbook of Genetic Algorithms, Lowrence Davis, Van Nostrand Reinhold
4. Multi-Objective Optimization using Evolutionary Algorithms, Kalyanmoy Deb, Wiley

IV-YEAR
(ELECTIVE-4)

MOBILE COMMUNICATION		**Course Code:** EC455	**Credits:** 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I:
Cellular concept, frequency reuse, channel assignment schemes, handoff strategies, interference and system capacity, trunking, grade of service, coverage and capacity enhancement techniques

Unit II: Mobile radio propagation-free space propagation model, two ray model, link budget using path loss models, outdoor and indoor propagation models, small scale fading-multipath propagation, IR model, multipath measurements, parameters of multipath channels, small scale fading, statistical models for multipath fading channels

Unit III:
Modulation techniques-overview of digital modulation, line coding, pulse shaping techniques, spread spectrum modulation-PN sequence, DS-SS, FH-SS, modulation performance in fading and multipath channels, speech coding-vocoder, LPC.

Unit IV:
Multiple access techniques-FDMA, TDMA, spread spectrum multiple access- FHMA, CDMA, SDMA, packet radio-protocols, CSMA protocols, reservation protocols, capacity of cellular systems.

Unit V:
GSM-services and features, architecture, radio sub systems, channels types, frame structure and signal processing, CDMA-specifications, forward and reverse CDMA channels, CT2, DECT, PACS, PDC, PHS.

Text Books:

[1] Theodore S. Rappaport, Wireless Communication, Principles and Practice, Pearson.
[2] Kaveh Pahlavan, Prashant Krishnamurthy, Principles of Wireless Networks, PHI.

Reference Books:

[3] W.C. Jakes, Microwave Mobile Communication, IEEE Press
[4] Kaveh Pahlavan & Allen H. Levesque, Wireless Information Networks, Wiley series in Telecommunications and Signal Processing.
[5] Kamilo Feher, Wireless Digital communications, Modulation and Spread Spectrum Applications. PHI

IV-YEAR
(ELECTIVE-4)

SATELLITE COMMUNICATION		Course Code: EC457	Credits: 3
No. of Lectures (Hrs/Week): 3	**No. of Lectures (Sem.):** 45	**Mid Sem. Exam (Hrs):** 1.5	**End Sem. Exam (Hrs):** 3

Unit I: Overview of Satellite System, Orbits and Launching Methods
Frequency Allocations, Intelsat, U.S. Domsats, Polar Orbiting Satellites, Problems, Kepler's Law, Definitions of Terms for Earth-orbiting Satellites, Orbital Elements, Effects of a Non-spherical Earth, Atmospheric Drag, Inclined Orbits ,Calendars , Universal , Sidereal Time, Julian Dates , The Orbital Plane – The Geocentric-, Topcentric-Horizon, The Sub-satellite Point – Predicting Satellite Position.

Unit II: Geostationary Orbit and Space Segments
Antenna Look Angels, The Polar Mount Antenna, Limits of Visibility, Near Geostationary Orbits, Earth Eclipse of Satellite, Launching Orbits, Problems, Power Supply, Attitude Control, Spinning Satellite Stabilization Momentum Wheel Stabilization, Station Keeping, Thermal Control, Transponders, Wideband Receiver, Power Amplifier, Antenna Subsystem, Morelos, Advanced Spacecraft.

Unit III: Earth Segment and Space Link
Equivalent Isotropic Radiated Power, Transmission Losses, Free-Space Transmission, Feeder Losses, Antenna Misalignment Losses, Fixed Atmospheric and Ionospheric Losses, Link Power Budget Equation, System Noise, Antenna Noise, Amplifier Noise Temperature, Amplifiers in Cascade , Noise Factor, Noise Temperature, Overall System Noise Temperature, Carrier-to-Noise Ratio, Uplink, Saturation Flux Density, The Earth Station HPA, Downlink, Output Back off, Effects of Rain, Uplink rain-fade margin, fade margin, Combined Uplink and Downlink C/N Ratio, Inter modulation Noise.

Unit IV: Satellite Access
Single Access–Preassigned FDMA, Demand-Assigned FDMA, SPADE System. Bandwidth-limited a Power-limited TWT amplifier operation, FDMA downlink analysis. TDMA: Reference Burst; Traffic Date, Frame Efficiency and Channel capacity, pre-assigned TDMA, Demand assigned TDMA, Speech Interpolation and Prediction, Downlink analysis for Digital transmission. Companion of uplink Power requirements for FDMA & TDMA.

Unit V: Direct Broadcast Satellite Services
Introduction–Orbital Spacing–Power Rating and Number of Transponders–Frequencies and Polarization–Transponder Capacity–Home Receiver Outdoor Unit (ODU)–Home Receiver Indoor Unit (IDU)–Downlink Analysis–Uplink-Problems-Satellite Mobile Services–VSATs–Radarsat–Global Positioning Satellite System–Orbcomm.

Text Books:
[1] Dennis Roddy, Satellite Communications, McGraw-Hill Publication.
[2] Timothy Pratt – Charles Bostian & Jeremy Allmuti, Satellite Communications, Willy

Reference Books:
[3] Wilbur L. Pritchars, Henri G.Suyder Hond & Robert A.Nelson, Satellite Communication Systems Engineering, Pearson Education Ltd.

IV-YEAR
(ELECTIVE-4)

SECURITY IN WIRELESS NETWORKS		Course Code: EC459	Credits: 3
No. of Lectures (Hrs/Week): 3	No. of Lectures (Sem.): 45	Mid Sem. Exam (Hrs): 1.5	End Sem. Exam (Hrs): 3

Unit I: Security goals, attacks, services and mechanisms, cryptography and steganography

Unit II: Symmetric key ciphers-substitution ciphers, transposition ciphers, stream and block ciphers, algebraic structures and GF (2^n) fields in cryptography

Unit III: Modern block ciphers, modern stream ciphers, DES and AES, Elliptic curve cryptosystems

Unit IV: Message integrity, random oracle model, message authentication, Hash function, Integrity authentication , Digital signature- process, services, attacks, schemes, key management-symmetric key distribution, kerbros, symmetric key agreement, public key distribution

Unit V: Security in wireless LAN, IEEE802.11 security, eavesdropping, unauthorized access, interference and jamming, physical threats, counter majors, WEP, encryption, authentication, WPA, authorization, non-repudiation, authentication and secure session, security architecture, VPN, wireless access to the Internet

Text book

[1] Behrouz A. Forouzan, “Cryptography & Network Security” Tata McGraw Hill