Electronics& Communication Engineering Department

SYLLABI

BEC-01	FUNDAMENTAL OF ELECTRONICS ENGINEERING	
Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and minor and major theory & practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to identify schematic symbols and understand the working principles of electronic devices, e.g., Diode, Zener Diode, LED, BJT, JFET and MOSFET etc.
2. Able to understand the working principles of electronic circuits e.g. Rectifiers, Clipper, Clamper, Filters, Amplifiers and Operational Amplifiers etc. also understand methods to analyse and characterize these circuits
3. Able to understand the functioning and purposes of Power Supplies, Test and Measuring equipments such as multimeters, CROs and function generators etc.
4. Able to rig up and test small electronics circuits.

Topics Covered	
UNIT-I	
Semiconductor materials and properties: electron-hole concepts, Basic concepts of energy bands in materials, concept of forbidden gap, Intrinsic and extrinsic semiconductors, donors and acceptors impurities, Junction diode, p-n junction, depletion layer, v-i characteristics, diode resistance, capacitance, diode ratings (average current, repetitive peak current, non-repetitive current, peak inverse voltage). Diode Applications in rectifier, filters, voltage multipliers, load regulators, clipper and clamper circuits, Breakdown mechanism (Zener and avalanche), breakdown characteristics, Zener resistance, Zener diode ratings, Zener diode application as shunt regulator	9
UNIT-II	
Bipolar Junction Transistor (BJT): Basic construction, transistor action, CB, CE and CC configurations, input/output characteristics, Biasing of transistors-fixed bias, emitter bias, potential divider bias, comparison of biasing circuits. Transistor Amplifier: Graphical analysis of CE amplifier, concept of voltage gain, current gain, h- parameter model (low frequency), computation of Ai, Av, Ri, Ro of single transistor CE and CC amplifier configurations.	9
UNIT-III	
Field Effect Transistors (JFET and MOSFET): Basic construction, transistor action, concept of pinch off, maximum drain saturation current, input and transfer characteristics, characteristic	9

equation CG, CS and CD configurations, fixed & self-biasing. MOSFET: depletion and enhancement type MOSFET-construction, operation and characteristics. Computation of Av, Ri, Ro, of single FET amplifiers using all the three configurations. Operational Amplifiers: Concept of ideal operational amplifiers, ideal op-amp parameters, inverting, non-inverting and unity gain amplifiers, adders, difference amplifiers, integrators	
UNIT-IV	
Switching theory and logic design: Number systems, conversion of bases, Boolean algebra, logic gates, concept of universal gate, canonical forms, Minimization using K-map Operational Amplifiers Electronics Instruments: Working principle of digital voltmeter, digital multimeter (block diagram approach), CRO (its working with block diagram), measurement of voltage, current, phase and frequency using CRO	9
EXPERIMENTS **A. Compulsory Experiments** 1. To identify the components which are used in electronic circuits. 2. To get familiarization and to study the operation of a function generator instrument and visualize the types of waveforms produced by a function generator. 3. To study the CRO and to find the Amplitude and Frequency of a sinusoidal waveform using CRO. 4. To plot and analyze the forward and Reverse Characteristics of Si based P-N junction diode. 5. To implement a circuit to study the various applications of Operational Amplifier. 6. Study of half wave rectifier. 7. Operation of diode based clipper and clamper circuits. **B. Optional Experiments** 1. Implement a circuit to draw the characteristics of JFET in common source configuration. 2. Implement a circuit of half wave and full wave rectifiers with filters. 3. Implement a circuit to draw the characteristics of common emitter BJT amplifier.	
Books & References	
1. Electronic Devices and Circuits-Boylestad and Nashelsky, 6e, PHI, 2001. 2. Electronic Devices and Circuits, A Mottershead, PHI, 2000, 6e. 3. Digital Computer Design, Morris Mano, PHI, 2003. 4. Electronic Instrumentation-H.S. Kalsi, 2e, TMH, 2007.	

BEC-10	**ELECTRONICS WORKSHOP & PCB**	
Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three Viva voce, Practical work/record, attendance and Major Practical Examination
Course Outcomes	:	After completion of this course the students are expected to be able to demonstrate following knowledge, skills and attitudes

1. Understand the design processes and production methods used in the manufacture of a printed circuit board.
2. Understand the use of software techniques in the design and simulation of an

electronic circuit.

3. Understand the use and application of chemical itching and drilling in the manufacture of an electronic circuit.
4. Be able to design and manufacture a prototype printed circuit board and use it to assemble and test an electronic circuit.

Topics Covered

Experiments

Note: Minimum five experiments should be performed

1. Winding shop: Stepdown transformer winding of less than 5VA.
2. Soldering shop: Fabrication of DC regulated power supply.
3. Design a PCB using Etching & drilling.
4. Design a full wave center tapped rectifier & study the effect of capacitive filter & its output on a virtual oscilloscope.
5. Design a RLC resonance circuit & verify the transient & phase response for different values of R,L&C.
6. Design a half adder using discrete components & verify the timing diagrams.
7. Convert the power supply circuit into PCB & simulates its 2D & 3D view.
8. Coating of etched PCB to protect it from oxidation.

BEC-11	**NETWORK ANALYSIS & SYNTHESIS**

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to apply the Thévenin, Norton, nodal and mesh analysis to express complex circuits in their simpler equivalent forms.
2. Able to apply linearity and superposition concepts to analyze RL, RC, and RLC circuits in time and frequency domains.
3. Able to analyze resonant circuits both in time and frequency domains.
4. Able to construct and make time and frequency domain measurements on elementary RL, RC, and RLC circuits.
5. Understand the fundamental concepts of network analysis and synthesis of two-port passive networks.

Topics Covered

UNIT-I	
Signal analysis, Complex frequency, Network analysis, Network synthesis General characteristics and descriptions of signals, with associated wave forms, Unit step function, Unit impulse and ramp function. Introduction to network analysis, network elements, Initial and final conditions, Solution of network equations, maximum power transfer theorem, Milliman's theorem	9
UNIT-II	
Review of Laplace transforms poles and zeroes, Initial and final value theorems, Transform circuit, Thevenin's and Norton's theorems, System function, step and impulse responses, Convolution integral. Amplitude and phase responses. Network functions, Relation between port parameters, Transfer functions using two port parameters, Interconnection of two ports	9
UNIT-III	
Hurwitz polynomials, Positive real functions. Properties of real immittance functions, synthesis of LC driving point immittances, Properties of RC driving point impedances, Synthesis of RC impedances or RL admittances, Properties of RL impedances and RC admittances.	9
UNIT-IV	
Concept of Poles and Zeroes on the stability, Properties of Open Circuit and Short Circuit Parameters, Zeroes of transmission, Synthesis of Y_{21} and Z_{21} with 1Ωterminations, Introduction to active network synthesis.	9

Books & References

1. Franklin F. Kuo, "Network Analysis and synthesis", 2nd Edition, Wiley India Pvt Ltd.
2. Behrouz Peikari, "Fundamentals of Network Analysis & synthesis", Jaico Publishing House, 2006.
3. M.E. Van Valkenberg, "Network Analysis", 2nd Edition, Prentice Hall of India Ltd

BEC-12 DIGITAL ELECTRONICS & CIRCUITS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about basics of digital electronics.
2. Acquired knowledge about solving problems related to number systems and Boolean algebra.
3. Ability to identify, analyze and design combinational circuits.
4. Ability to design various synchronous and asynchronous sequential circuits.
5. Acquired knowledge about internal circuitry and logic behind any digital system.

Topics Covered

UNIT-I	9

Digital system and Binary numbers: Signed binary numbers, Floating point number, Binary Codes, Cyclic codes, Error detecting and correcting codes, Hamming codes. NAND and NOR implementation, Minimization of circuit using K-map and Tabular method up to five variables, POS and SOP simplification, Logic family- TTL, DTL, ECL, CMOS, HMOS	
UNIT-II	9
Combinational Logic: Analysis and Design procedure for Combinational circuits, Binary adder/subtractor, Binary multiplier, Booth Algorithm, Magnitude comparator, Encoder/ Multiplexer, Decoder/ Demultiplexer.	
UNIT-III	9
Sequential logic: Sequential circuits, Latches, Flip-flops, Conversion of flip-flops, Analysis of clocked sequential circuits, State reduction and assignments. Registers and counters: Shift registers, Asynchronous counter, Synchronous counter, Sequential circuit analysis and design procedure, Circuit with latches, Hazards.	
UNIT-IV	9
Memory and programmable logic: Read only Memory, Read/Write Memory-SRAM and DRAM. Programmable Logic Devices,-PLAs, PALs and their applications; Sequential PLDs and their applications; State machine design with sequential PLDs: Introduction, to field programmable gate arrays (FPGAs).	

EXPERIMENTS

A. Compulsory Experiments

1. Design and verification of following arithmetic circuits using 74xx family ICs.
    a. Half adder and Full adder
    b. Half subtractor and full subtractor
2. To perform the code conversion- binary to gray and gray to binary and its truth table verification.
3. To design a combinational logic circuit using 74xx family ICs and its truth table verification in both SOP and POS forms.
4. Realization of 2:4 decoders and 4:2 encoder circuit and verification of its truth table.
5. To design and verify the truth table of multiplexer and demultiplexer circuits.
6. To design a 1-bit comparator using 74xx family ICs and to study the performance of 4-bit comparator IC 7485.
7. Design and verification of basic Flip-Flops using 74xx family ICs and master-slave JK flip-flop using IC 7476.

B. Optional Experiments

8. To realize and verify the truth table of shift register-SIPO/SISO and PISO/PIPO.
9. Design and verification of asynchronous counter design and Mod-n counter.
10. To realize and verify the truth table of synchronous counter design.
11. To conduct an experiment to store a set of data in a RAM using IC 7489 starting from location -------- to location ---------- and retrieve the same data.
12. To study and verify the functional table of 4-bit ALU using IC 74181.

Books & References

1. Hill & Peterson, “Switching Circuit & Logic Design”, Wiley.
2. Digital principle and applications Malvino and Leach- (TMH)

BEC-13	**SIGNALS & SYSTEMS**

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to describe signals mathematically and understand how to perform mathematical operations on signals.
2. Understand various signals and systems properties and be able to identify whether a given system exhibits these properties and its implication for practical systems.
3. Understand the process of convolution between signals, & able to solve differential equation using Laplace transforms techniques.
4. Understand the intuitive meaning of frequency domain and the importance of analyzing and processing signals in the frequency domain.
5. Able to compute the Fourier series or Fourier transform Z-transform, and further be able to use the properties and application in analysis to ideal filtering, amplitude modulation and sampling.
6. Able to analysis and design of linear time invariant systems used in engineering

Topics Covered	
UNIT-I	9
Signals: Definition, types of signals and their representations: Continuous-time/discrete-time, Periodic/non-periodic, Even/Odd, Energy/Power, Deterministic/Random, One dimensional /Multidimensional, Commonly used signals (in continuous-time as well as in discrete-time): Unit impulse, Unit step, unit ramp (and their interrelationships), Exponential, Rectangular pulse, Sinusoidal; Operations on continuous-time and discrete-time signals (including transformations of independent variables). **Systems:** Classification, Linearity, Time-invariance and causality, Impulse response, Characterization of linear time-invariant (LTI) systems, Unit sample response, Convolution summation, Step response of discrete time systems, Stability, Poles and zeros	
UNIT-II	9
Fourier Series (FS) and Fourier Transforms (FT): (i) Fourier series representation and some important properties (ii) Definition, conditions of existence of FT, properties, Magnitude and phase spectra, Some important FT theorems, Parseval's theorem, Inverse FT, relation between LT and FT (iii) Discrete time Fourier transform (DTFT), Inverse DTFT, Convergence, Properties and theorems, Comparison between continuous time FT and DTFT	
UNIT-III	9
Laplace-Transform (LT) and Z-transform (ZT): (i) One-sided LT of some common signals, Important theorems and properties of LT, inverse LT, Solutions of differential equations using LT, Bilateral LT, Regions of convergence (ROC) (ii) One sided and Bilateral Z-transforms, ZT of some common signals, ROC, Properties and theorems, Solution of difference equations using one-sided ZT, s- to z-plane mapping	
UNIT-IV	9
Time and frequency domain analysis of systems	

Convolution integral, Co-relations, Signal energy and energy spectral density, signal power and power spectral density, Properties of power spectral density, Analysis of first order and second order systems, continuous-time (CT) system analysis using LT, System functions of CT systems, Block diagram representations; discrete-time system functions,block diagram representation, Illustration of the concepts of system bandwidth and rise time through the analysis of a first order CT low pass filter	

Books & References

1. Chi-Tsong Chen, `Signals and Systems', 3rd Ed., Oxford University Press, 2004
2. V. Oppenheim, A.S. Willsky and S. Hamid Nawab, 'Signals & System', Pearson Education, 2nd Ed.,2003
3. P. Ramakrishna Rao, `Signal and Systems' 2008 Ed., Tata McGraw Hill, New Delhi

BEC-14 ELECTROMAGNETIC FIELD THEORY

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Apply vector calculus to understand the behavior of static electric fields in standard configurations.
2. Describe and analyze electromagnetic wave propagation in free-space.
3. Describe and analyze transmission lines.
4. Work in a small team using cooperative learning rules.
5. Communicate electromagnetic concepts both orally and in writing.

Topics Covered

UNIT-I	9
Electrostatics: Electrostatic fields, Coulombs law and field intensity, Electric field due to charge distribution, Electric flux density, Gausses's Law – Maxwell's equation, Electric dipole and flux lines, Energy density in electrostatic fields. Electric field in material space: Properties of materials, Convection and conduction currents, conductors, Polarization in dielectrics, Dielectric Constants, continuity equation and relaxation time, Boundary condition. Electrostatic boundary value problems: Poisson's and Laplace's equations, General procedures for solving Poisson's or Laplace's equations, Resistance and capacitance, Method of images	
UNIT-II	9
Magnetostatics: Magneto-static fields, Biot-Savart's Law, Ampere's circuit law, Maxwell's equation, Application of Ampere's law, Magnetic flux density- Maxwell's equation, Maxwell's equation for static fields, magnetic scalar and vector potential. Magnetic forces, materials and devices: Forces due to magnetic field, Magnetic torque and moment, a magnetic dipole, Magnetization in materials, magnetic boundary conditions, Inductors and inductances, Magnetic	

energy. Waves and applications: Maxwell's equation, Faraday's Law, Transformer and motional electromotive forces, Displacement current, Maxwell's equations in differential and integral form	
UNIT-III	9
Electromagnetic wave propagation: Wave propagation in lossy dielectrics, Plane waves in lossless dielectrics, Plane wave in free space, Plain waves in good conductors, Power and the Poynting vector, Reflection and Refraction of a plane wave at normal and Oblique incidence.	
UNIT-IV	9
Transmission lines: Transmission line parameters, Transmission line equations, Input impedance, Standing wave ratio and power, The Smith chart, Coaxial lines and Waveguides.	

Books & References

1. W. H. Hayt and J. A Buck "Electromagnetic field Theory" 7th Ed. TMH
2. M. N. O. Sadiku, "Elements of Electromagnetics", 4th Ed, Oxford University Press

BEC-15 SOLID STATE DEVICES & CIRCUITS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the basic operation and working of different diodes like PIN, Varactor diode etc.
2. To understand the high frequency application of diodes.
3. To understand and use of the device models to explain and calculate the characteristics of the field effect transistors.
4. To be able to understand and analyze the V-I characteristics of different high power devices.
5. Understand the operation of charge-transfer devices and charge storage device.

Topics Covered

UNIT-I	9
Crystal Properties and charge Carriers in Semiconductors, Elemental and compound semiconductor materials, crystal lattice structure, Bonding forces and energy bands in solids, charge carriers in semiconductors, Donor/Acceptor carrier concentrations, Mobility and Conductivity, drift of carriers in electric and magnetic fields, Potential variation within a graded semiconductor, p-n junction behavior, Charge control description of a diode. Special Diodes: Varactor diode, Zener Diode, Schottky barrier diode, Light Emitting diode, Photo diode, Characteristics and applications.	
UNIT-II	9
BJT: Review of device structure operation and V-I characteristics, BJT circuits at DC, BJT as	

amplifier and switch, biasing in BJT amplifier circuit, small-signal operation and models, single stage BJT amplifier, BJT internal capacitances and high frequency model, frequency response of CE amplifier. Darlington pair, BJT differential pair, Cascode and Cascade amplifier.	
UNIT-III	9
MOSFET: Review of device structure operation and V-I characteristics. Circuits at DC, MOSFET as Amplifier and switch, Biasing in MOS amplifier circuits, small-signal operation and models, single stage MOS amplifier, MOSFET internal capacitances and high frequency model, frequency response of CS amplifier.	
UNIT-IV	9
Feedback Amplifiers: The general feedback structure, properties of negative feed- back, the four basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, the shunt-shunt and shunt-series feedback amplifier. **Oscillators:** Basic principles of sinusoidal oscillators, RC Phase-shift Oscillator circuits, Resonant-circuit oscillators.	

EXPERIMENTS

1. Study of JFET drain and transfer characteristics.
2. JFET biasing arrangement Graphical method.
3. Build and Test JFET CS amplifier. Find performance parameters for JFET amplifier - A_V, Ri, R_O.
4. Simulation of JFET CS amplifier using multisim/spice.Find performance parameters for JFET amplifier - A_V, Ri, R_O and compare with theoretical and practical results.
5. Input and Output Characteristics of BJT CE configuration. Find h parameters from characteristics.
6. Build and Test BJT in CE amplifier and find performance parameters - A_V, Ri, R_O, Ai
7. Simulation of BJT CE amplifier using multisim/spice.
8. Find performance parameters for BJT amplifier - A_V, Ri, R_O,Ai and compare with theoretical and practical results.
9. Comparison of CE, CC, CB configurations in terms of A_V, Ri, R_o ,Ai
10. Study of MOSFET drain and transfer characteristics
11. Frequency response - For BJT/ FET single stage amplifiers - Effect of unbypassedR_E and R_S.
12. Effect of coupling and bypass capacitors on low frequency cut-off.

Books & References

1. Milman, Halkias&Jit- Electronics Devices and Circuits- TMH
2. Donald ANeaman, “Semiconductor Physics and Devices Basic Principles”, 3e, TMH India.

BEC-26 CONTROL SYSTEMS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Describe the response characteristic and differentiate between the open loop and closed loop of a control system.
2. Derive mathematical model for simple electrical and mechanical systems using transfer function and state variable method.
3. Determine the response of a control system using poles and zeros to determine the response of a control system.
4. Determine the stability of a control system using Routh-Hurwitz method.

Topics Covered

UNIT-I	9
Basic Components of a control system, Feedback and its effect, Types of feedback control Systems, Block diagrams: representation and reduction, Signal Flow Graphs, Modeling of Physical Systems: Electrical Networks and Mechanical Systems, Force-voltage analogy, Force-current analogy.	
UNIT-II	9
Time response of continuous data systems, Different test Signals for the time response, Unit step response and Time-Domain Specifications, Time response of a first-order and second order systems for different test signals, Steady State Error and Error constants, Sensitivity, Control Actions: Proportional, Derivative, Integral and PID control. Introduction to Process Control Systems, Pneumatic hydraulics, Actuators.	
UNIT-III	9
Stability: Methods of determining stability, Routh Hurwitz Criterion, Root Locus, Frequency Domain Analysis: Resonant Peak, Resonant frequency and Bandwidth of the second order system, Effect of adding a zero and a pole to the forward path, Nyquist Stability Criterion, Relative Stability: Gain Margin and Phase Margin, Bode Plot.	
UNIT-IV	9
State-Space Analysis of Control System: Vector matrix representation of state equation, State transition matrix, Relationship between state equations and high-order differential equations, Relationship between state equations and transfer functions, Block diagram representation of state equations, Decomposition Transfer Function, Kalman's Test for controllability and observability	

EXPERIMENTS

1. To determine transfer function of (Metadyne) cross-field generator set & study of various associated characteristics.
2. To study the synchros in various configurations from application point view
3. To study the D.C. Servo-position control system with P & PI configurations
4. To study the A.C. Servo motor and determine the Speed-Torque Characteristics.
5. To study 1st order and 2nd order system time response using MATLAB software.
6. To study Root Locus Plot using MATLAB software.
7. To study Frequency response Plot (Polar plot, Nyquist plot, Bode plot) using MATLAB software.

Books & References

1. B.C. Kuo &FaridGolnaraghi, "Automatic Control Systems", 8e, John Wiley India, 2008.
2. I.J. Nagrath & M.Gopal, "Control System Engineering", New Age International Publishers.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2010.
4. Katsuhiko Ogata, "Modern Control Engineering", 3e, PHI Publication, 2000.

BEC-27	**ANALOG INTEGRATED CIRCUITS**

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will be able to learn about the operational amplifiers and its characteristics as well as various types of op-amps.
2. Students will acquire the ability to design and test practical circuits for amplifiers, filters and oscillators.
3. Students will be able to analyze the operation of comparators, data convertors and implementation of the same.
4. Students will be able to learn the functioning of PLL, VCO, V-I, I-V converters, AGC, AVC and analog multipliers and implement them for suitable applications

Topics Covered	
UNIT-I	9
Introduction to Integrated Circuit Design: Power Supply configurations for Op-amp application, Various types of Op-amp, Current mirrors using BJT and MOSFETs, Base current compensated mirrors, Wilson current mirrors, Widlar current source.	
UNIT-II	9
Linear and Nonlinear applications of IC Op-amp: An overview of Op-amp, V-I and I-V converters, Log-antilog amplifiers, Precision rectifier, Peak detector, Sample and Hold Circuits, Analog multiplier and their applications, Op-amp as a comparator, Zero-crossing detector, Schmitt trigger, Astable and Monostable multivibrator using Op-Amp, Generation of triangular waveform	
UNIT-III	9
Filters: Characteristics of filters, Classification of filters, Butterworth filters, Chebyshev filters, Bessel filters, Low Pass and High Pass filters, Band Pass filters, Band reject filters, Notch filters.	
UNIT-IV	9
Advanced applications of an Op-amp: Frequency Divider, PLL IC, 555 IC timer, Design of Astable and Monostable Multivibrators using 555 Timer IC, Standard Regulator ICs and their characteristics.	

EXPERIMENTS

A. Compulsory Experiments

1. Study the characteristics of negative feedback amplifier
2. Design of an instrumentation amplifier.
3. Design and test an astable multivibrator for a given frequency.
4. Study the characteristics of integrator circuit.
5. Design of Analog filters.
6. Design of a Phase Locked Loop(PLL)
7. Design of a Voltage Controlled Oscillator.

B. Optional Experiments

1. To obtain the frequency response of CE amplifier and to see the effect of feedback on the frequency response.
2. Design and test of current mirror circuit, current repeater and widlar current source circuit.
3. Realization of Schmitt trigger circuit using IC 741.
4. Study of Darlington pair circuit and its overall current gain.
5. Op-amp (741) as an integrator and realization of low pass filter, and op-amp as differentiator and realization high pass filter.
6. (a) Verify the operation of voltage comparator circuit using IC 741.
   (b) Verify the operation of zero crossing detector circuit using IC 741.

Books & References

1. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf
2. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf
3. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf
4. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf
5. ASLK Pro Manual: ASLK Manual
6. *Ramakant A. Gayakwad, "Op-amps and Linear Integrated Circuits", PHI*
7. *Millman and Grabel, "Microelectronics", 2nd Ed., Mcgraw Hill*
8. *D. Roy Chudhry, "Linear Integrated Circuits", New Age International*

BEC-28 PRINCIPLES OF COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Signals & Systems (BEC-13)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about analog communication.
2. Acquired knowledge about AM transmission and reception.
3. Acquired knowledge about FM and PM transmission and reception.
4. Acquired knowledge about pulse modulation.

5. Acquired knowledge about noise.	
Topics Covered	
UNIT-I	9
Amplitude Modulation: Overview of Communication system, Communication channels, Need for modulation, Baseband and Pass band signals, Comparison of various AM systems **Amplitude Modulation:** Double side-band with Carrier (DSB-C), Double side-band without Carrier, Single Side-band Modulation, SSB Modulators and Demodulators, Vestigial Side-band (VSB), Quadrature Amplitude Modulator.	
UNIT-II	9
Introduction to Angle Modulation: Frequency modulation, Narrowband and Wideband FM, Generation of FM waves, Indirect FM and direct FM, FM modulators and demodulators, Phase locked loop, Angle Modulation by Arbitrary Message Signal, Phase Modulation, Pre-emphasis and De-emphasis, Linear and Nonlinear Modulation, Comparison between Angle Modulation and Amplitude Modulation, Radio Receivers.	
UNIT-III	9
Noise: Source of Noise, Frequency domain, Representation of noise, Linear Filtering of noise, Noise in Amplitude modulation system, Noise in SSB-SC,DSB and DSB-C, Noise Ratio, Noise Comparison of FM and AM, Pre-emphasis and De-emphasis, Figure of Merit	
UNIT-IV	9
Pulse Modulation and Digital Transmission of Analog Signal: Sampling Theorem and its applications, Concept of Pulse Amplitude Modulation, Pulse width modulation and pulse position modulation, PCM, Pulse Time Modulation, TDM and FDM. Line Coding, Quantizer, Quantization Noise, Compounding multiplexer.	

EXPERIMENTS

A. Compulsory Experiment:

1. To study Amplitude modulation using a transistor and determine depth of modulation.
2. To study envelope detector for Demodulation of AM singnal and observe diagonal clipping.
3. To study frequency modulation using reactance modulator.
4. Narrow band FM generation using varactor modulator.
5. Generation of DSB-SC signal using balance modulator.
6. Generation of single side band signal.
7. Study of PLL and detection of FM signal using PLL

B. **Optional Experiments:**

8. To study and implement Pre-emphasis and De-emphasis circuits.
9. To design and test the circuits of voltage to frequency converter using IC-555.
10. To understand and implement Pulse Amplitude Modulation (PAM) using IC-555.
11. To understand and implement Pulse Width Modulation (PWM) using IC-555.
12. To understand and implement Pulse Position Modulation (PAM) using IC-555.

Books & References

1. H. Taub, D L Schilling, Goutom Saha, “Principles of Communication”, 3e, Tata McGraw-Hill Publishing Company Ltd.
2. B.P. Lathi, “Modern Digital and Analog communication Systems”, 3e, Oxford University Press, 2009.
3. Simon Haykin, “Communication Systems”,4e, Wiley India.
4. H. P. HSU & D. Mitra, “Analog and Digital Communications”, 2e, Tata McGraw-Hill Publishing Company Ltd.

BEC-29	ELECTRONIC MEASUREMENT & INSTRUMENTATION	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand operation of different instruments.
2. Able to describe different terminology related to measurements.
3. Understand the principles of various types of transducers and sensors.
4. Basic concept of instrumentation and its industrial application and working & performances of different kind of measuring instruments.
5. Ability to analyze performance characteristics of measuring instruments.
6. Ability to know, working principle & Performances of different electrical transducers.
7. Ability to understand construction, principle of operation, working and applications of waveform analyzers and spectrum analyzers, CRO and other display devices.
8. Ability to understand principle of operation of telemetry system and data acquisition system.
9. Ability to understand principle of operation of process control system and its various applications

Topics Covered

UNIT-I	9
Qualities Measurements and Digital Display Devices: Performance Characteristics, Error in Measurement, Sources of Error, Arithmetic Mean, Deviation from the Mean, Average Deviation, Standard Deviation, Limiting Errors. Digital Display Device: LED, LCD, Gas Discharge Plasma Displays, Incandescent Display, LVD (Liquid Vapour Display), Pointers, Digital Voltmeters, Spectrum Analysis.	
UNIT-II	9
Transducers: Introduction, Selection Parameters of Transducer, Resistive Transducer, Strain Gauges, Inductive Transducer, Differential Output Transducers, LVDT, Capacitive Transducer, Photo-electric Transducer, Photo cells, Photo-Voltaic Cell, Photo Transistors, Temperature Transducers, Mechanical Transducer.	
UNIT-III	9
Data Acquisition and Conversion: Introduction, Objective of Data Acquisition System, Multichannel DAS, A/D and D/A converters using Op-Amp, Data Loggers, Electromechanical A/D Converter, Digital Transducer, Frequency Standards.	
UNIT-IV	9
Measurement of Power and Frequency: Introduction, Power Measurement by Bolometer	

element, Bolometer Mount and Bolometer Bridge, Measurement of Power on a Transmission Line, Measurement of Microwave Frequencies, Resonant Coaxial Lines, Cavity Wave meter.

EXPERIMENTS

1. Study of semiconductor diode voltmeter and its us as DC average responding AC voltmeter.
2. Study of L.C.R. bridge and determination of the value of the given components.
3. Study of distortion factor meter and determination of the % distortion of the given oscillator.
4. Study of the transistor tester and determination of the parameters of the given transistors.
5. Study of the following transducer (i) PT-100 transducer (ii) J- type transducer (iii) K-type transducer (iv)Pressure transducer.
6. Measurement of phase difference and frequency using CRO (lissajous figure)
7. Measurement of low resistance using Kelvin's double bridge.
8. Radio Receiver Measurements

Books & References

1. David A. Bell, "Electronic Instrumentation and Measurements", 2nd Ed., PHI, New Delhi 2008.
2. H. S. Kalsi, "Electronic Instrumentation", 3rd Ed., McGraw Hill Education(India), 2015

BEC-30 SEMINAR

Course category	:	Audit Course (AC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 6
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through quality of material, presentation, quality & extent of external response of question asked and participation in other seminars (attendance)
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To acquire in depth study in a specialized area.

2. Acquaint the students of methods of carrying our literature survey on a given topic.

3. Derive a balance between the depth of the work and understanding of what has been learned in this process.

4. To be able to prepare seminar report and presentation and deliver it effectively.

BEC-31 DIGITAL COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this

		course

1. Able to compute the bandwidth and transmission power by analysing time and frequency domain spectra of signal required under various modulation schemes.
2. Able to apply suitable modulation schemes and coding for various applications.
3. Able to identify and describe different techniques in modern digital communications, in particular in source coding, modulation and detection, carrier modulation, and channel coding.
4. Able to analyze digital modulation techniques by using signal processing tools.

Topics Covered

UNIT-I	9
Overview of digital communication, Overview of PCM system and Quantization, Differential PCM, Delta modulation, Adaptive Delta Modulation. Baseband Binary transmission inter symbol interference (ISI), Nyquist criterion for zero ISI, pulse shaping and raised-cosine filter, duobinary coding, Modified Duobinary.	
UNIT-II	9
Probability theory and Random Variables, Random variable, Probability mass function, cumulative distribution function, Probability Density function, Statistical averages, Gaussian distribution, Binomial Distribution, Sum of Random Variables, Central Limit Theorem, Transformation of random variables, Random Process, Classification of Random Processes, Auto correlation function, Power spectral density, Multiple random processes, Gaussian Process.	
UNIT-III	9
Digital Modulation Techniques: Digital Modulation formats, Digital carrier system, Gram Schmidt Orthogonalization procedure, Method of generation and detection of coherent & noncoherent binary ASK, FSK & PSK, Differential phase shift keying, quadrature modulation techniques. (QPSK and MSK), Mary Digital carrier Modulation. Matched Filter, Overview of spread spectrum systems.	
UNIT-IV	9
Information Theory and Coding: Information Theory and Coding: Information Measurement, Average information and information rate, Coding for discrete memory less source, continuous channel capacity, Maximum entropy, Huffman and **Shannon** Fano coding, Discrete channel capacity, Trade –off between S/N and bandwidth, **Error control coding**, Block code, Hamming code, Cyclic code, Convolutional code: Tree diagram, State diagram, Trellis diagram.	

EXPERIMENTS

A. Compulsory Experiments

1. To design of Sample and hold circuit using Op-amp
2. To construct a pulse amplitude modulation (PAM) and demodulation circuit and to observe the waveform.
3. To understand and implement Pulse Width Modulation (PWM) using IC 555 by varying the amplitude of the modulating signal and plot the relevant waveforms.
4. To understand and implement Pulse Position Modulation (PPM) using IC 555 and plot the relevant waveforms.
5. Study of delta modulation and demodulation and observe effect of slope overload DCL07.
6. Study of pulse data coding techniques for NRZ formats.
7. Data decoding techniques for NRZ formats. ST21067.

B. Optional Experiments

1. To Study and implement of amplitude shift keying modulator and demodulator and to observe the waveform.
2. To Study and implement of FSK modulator and demodulator and to observe the waveform.

3. Study of phase shift keying modulator and demodulator ST467.
4. Study of single bit error detection and correction using Hamming code. ST2103.
5. Implementing Convolutional Encoder/Decoder using MATLAB.
6. Implementing ASK, PSK and FSK using SIMULINK.

Books & References

1. Haykin, Simon, "Communication Systems", John Wiley, 4e.
2. Singh, R.P. &Sapre, S.D. "Communication Systems: Analog & Digital", Tata McGraw-Hill.
3. Lathi, B.P, "Modern Digital & Analog Communication Systems", Oxford University Press.
4. Taub& Schilling, "Principles of Communication Systems", Tata McGraw-Hill
5. Prokis J.J, "Digital Communications", McGraw Hill

BEC-32 MICROPROCESSORS & APPLICATIONS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Digital Electronics and Circuits(BEC-12)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about Microprocessors and its need.
2. Ability to identify basic architecture of different Microprocessors.
3. Foster ability to write the programming using 8085 microprocessor.
4. Foster ability to understand the internal architecture and interfacing of different peripheral devices with 8085 Microprocessor.
5. Foster ability to write the programming using 8086 microprocessor.
6. Foster ability to understand the internal architecture and interfacing of different peripheral devices with 8086 Microprocessor.

Topics Covered

UNIT-I	9
Introduction to Microprocessors: Evolution of Microprocessors, Microprocessor Architecture and its operations, Memory devices, I/O Devices, 8-bit Microprocessor (8085): Introduction, Signal Description, Register Organization, Architecture, Basic Interfacing Concepts for Memory and I/O Devices	
UNIT-II	9
8085 Assembly Language Programming: Instruction Classification, Instruction Format, Addressing Modes, 8085 Instructions: Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Flow Chart, Writing assembly language programs, Programming techniques: looping, counting and indexing.	
UNIT-III	9
16-bit Microprocessors (8086/8088): Architecture, Physical address segmentation, memory	

organization, Bus cycle, Addressing modes, difference between 8086 and 8088, Introduction to 80186 and 80286, Assembly Language Programming of 8086/8088.	
UNIT-IV	9
Data Transfer Schemes: Introduction, Types of transmission, 8257 (DMA), 8255 (PPI), Serial Data transfer (USART 8251), Keyboard-display controller (8279), Programmable Interrupt Controller (8259), Programmable Interval Timer/ Counter (8253/8254): Introduction, modes, Interfacing of 8253, applications, ADC and DAC	

EXPERIMENTS

1. Write a program using 8085 Microprocessor for Decimal addition and subtraction of two numbers.
2. Write a program using 8085 Microprocessor for Hexadecimal addition and subtraction of two numbers.
3. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers.
4. To perform multiplication and division of two 8 bit numbers using 8085.
5. To find the largest and smallest number in an array of data using 8085 instruction set.
6. To write a program to arrange an array of data in ascending order.
7. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8085 instruction set.
8. To write a program to initiate 8251 and to check the transmission and reception of character.
9. To interface 8253 programmable interval timer to 8085 and verify the operation of 8253 in six different modes.
10. To interface 8255 with 8085 and verify the operation of 8255 in different modes.
11. To interface 8259 with 8085 and verify the operation of 8259.
12. Serial communication between two 8085 microprocessors through RS-232 C port.

Books & References

1. R. Singh and B. P. Singh: Microprocessor Interfacing and Application, New Age International Publishers, 2nd Edition.
2. D. V. Hall: Microprocessors Interfacing, TMH (2nd Edition).
3. R. S. Gaunkar: Microprocessor Architecture, Programming and Applications with 8085/8080, Penram Publication
4. Y.C. Liu and G.A. Gibson: Microcomputer Systems: The 8086/8088 Family Architecture Programming and Design, PHI 2nd Edition,

BEC-33 DATA COMMUNICATION NETWORKS

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to describe communication protocols and layered network architectures.
2. Able to explain conventional computer system interfacing standards and peer to peer data link communication protocols.

3. Able to design basic network systems and various components in a data communication system.
4. Able to describe how the physical, data link, and network layers operate in a typical data communication system.
5. Able to understand the system design principles of data communication systems.
6. Able to understand, define and explain data communications networks concepts

Topics Covered

UNIT-I	9
Introduction to Networks & Data Communications The Internet, Protocols & Standards, Layered Tasks, OSI Model, TCP / IP, Addressing, Line Coding Review, Transmission Media: Guided and unguided Media Review	
UNIT-II	9
Switching: Datagram Networks, Virtual Circuit Networks, Structure of a switch ,Ethernet Physical Layer, Data Link Layer: Error detection and Correction Data Link Control: Framing, Flow and Error Control Protocols, Noiseless and Noisy Channel Protocols, HDLC, Point-to-Point Protocol.	
UNIT-III	9
Multiple Access: RANDOM, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth, IEEE 802.16	
UNIT-IV	9
Network layer: Design Issues. Routing Algorithms. Congestion control Algorithms. IPV4 Addresses, Connecting Devices, IPV6 Addresses, Hardware Addressing versus IP Addressing, Transport Layer Protocol: UDP and TCP. Application Layer Protocol : SIP, DNS, FTP, HTTP, SMTP and SNMP.	

Text Books

1. Behrouz A. Forouzan (2006), Data communication and Networking, Tata McGraw-Hill, India.
2. A.S. Tanenbaum, Computer Networks (2003), 5 ed, Pearson Education/ PHI. New Delhi, india.

Reference Books

1. Micheal A Gallo, Bill Hancock , (2001),Computer Communications and Networking Technologies, Thomson Fitz Gerald , Dennis(2009), Business Data Communications & Networking, 10 ed, john willeysons, USA.
2. William stallings (2006), Cryptography and network security, 4th edition, Pearson Education, india.

BEC-34 MICROWAVE ENGINEERING

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Electromagnetic Field Theory (BEC-14)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the

		following knowledge, skills and attitudes after completing this course

1. Able to apply electromagnetic theory to calculations regarding waveguides and transmission lines.
2. Able to describe, analyze and design simple microwave circuits and devices e.g. matching circuits, couplers, antennas and amplifiers.
3. Able to describe and coarsely design common systems such as radar and microwave transmission links.
4. Able to describe common devices such as microwave vacuum tubes, high-speed transistors and ferrite devices.
5. Able to handle microwave equipment and make measurements.

Topics Covered

UNIT-I	9
Rectangular Wave Guide: Field Components, TE, TM Modes, Dominant TE_{10} mode, Field Distribution, Power, Attenuation. Circular Waveguides: TE, TM modes. Wave Velocities, Micro-strip Transmission line (TL), Coupled TL, Strip TL, Coupled Strip Line, Coplanar TL, Microwave Cavities.	
UNIT-II	9
Scattering Matrix, Passive microwave devices: Microwave Hybrid Circuits. , Terminations, Attenuators, Phase Shifters, Directional Couplers: Two Hole directional couplers, S Matrix of a Directional coupler, Hybrid Couplers, Microwave Propagation in ferrites, Faraday Rotation, Isolators, Circulators. S parameter analysis of all components.	
UNIT-III	9
Microwave Tubes: Limitation of Conventional Active Devices at Microwave frequency, Two Cavity Klystron, Reflex Klystron, Magnetron, Traveling Wave Tube, Backward Wave Oscillators: Solid state amplifiers and oscillators: Microwave Bipolar Transistor, Microwave tunnel diode, Microwave Field-effect Transistor, Transferred electron devices, Avalanche Transit –time devices: IMPATT Diode, TRAPPAT Diode.	
UNIT-IV	9
Microwave Measurements: General set-up of a microwave test bench, Slotted line carriage, VSWR Meter, microwave power measurements techniques, Crystal Detector, frequency measurement, wavelength measurements. Impedance and Refection coefficient, VSWR, Insertion and attenuation loss measurements, measurement of antenna characteristics, microwave link design	

EXPERIMENTS

A. Compulsory Experiment

1. To determine the frequency and wavelength of a microwave in a rectangular waveguide operated in TE10 mode.
2. To measure the frequency of a microwave source and demonstrate relationship among guide dimensions, free space wavelength and guide.
3. To study the characteristics of the reflex klystron tube and to determine its electronic tuning range.
4. To study the characteristics of Gunn Diode and to determine the threshold voltage.
5. To measure the standing wave ratio and reflection coefficient in a Microwave Transmission line.
6. To measure coupling coefficient, Insertion loss & Directivity of a Directional coupler.
7. To study isolation and coupling coefficient of a magic Tee.

B. Optional Experiments

8. To study the substitution method for measurement of attenuation and hence.
    i. to determine attenuation due to a component under test.
    ii. to study variations in its attenuation with the frequency.
9. Study of wave guide horn and its radiation pattern and determination of the beam width.
10. To measure isolation and insertion loss of a three port Circulators/Isolator.

Textbooks & Reference books

1. Liao, S.Y. / Microwave Devices & Circuits; PHI 3rd Ed.
2. Collin, R.E. Foundations for Microwave Engineering; TMH 2nd Ed.
3. Rizzi, Microwave Engineering: Passive Circuits; PHI.
4. A Das and S.K. Das, Microwave Engineering; TMH.

BEC-35	**VLSI TECHNOLOGY**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand the fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.
5. Able to explain basic operation principles of diodes and MOS transistors and their circuits level models
6. Able to design the fundamental blocks of a VLSI circuits, both by circuit schematic and physical layout
7. Able to analyze the influence of wires/interconnects on VLSI circuit performance.

Topics Covered

UNIT-I	9
Fundamentals of VLSI Technology: Introduction, Trends & Projections in microelectronics. Semiconductor materials and their merits and demerits. Monolithic chips trends. Advantages, limitations & classification of ICs. **Source of silicon**; EGS and MGS, Single crystalline and Poly-crystalline crystal, SGS	
UNIT-II	9

Fabrication Techniques: float zone method, Czocharalski method, Refining, Silicon Wafer Preparation & Crystal Defects. **Epitaxial Process:** Need of epitaxial layer; VPE, MBE, merits and demerits of various epitaxial processes. **Oxidation Techniques:** Importance of oxidation, types of oxidation techniques, growth mechanism, factors affecting the growth mechanisms, silicon oxidation model, dry & wet oxidation. **Diffusion and Ion Implantation:** Diffusion mechanisms; diffusion reactor; diffusion profile; diffusion kinetics; parameters affecting diffusion profile; Dopants and their behaviour, choice of dopants; Ion Implantation- reactor design, impurity distribution profile, properties of ion implantation, low energy and high energy ion implantation.	
UNIT-III	9
Lithography: Basic steps in lithography; lithography techniques-optical lithography, electron beam lithography, x-ray lithography, ion beam lithography; resists and mask preparation of respective lithographies, printing techniques-contact, proximity printing and projection printing. **Etching:** Performance metrics of etching; types of etching- wet and dry etching; dry etching techniques-ion beam or ion-milling, sputter ion plasma etching and reactive ion etching (RIE). **Metallization:** Desired properties of metallization for VLSI; metallization choices; metallization techniques –vacuum evaporation, sputtering.	
UNIT-IV	9
Fabrication steps of Diodes and Transistors, MOSFETs, CMOS, Resistors, Capacitors.	

Books & References

1. S.M. Sze, "VLSI Technology", TMH
2. S.K. Gandhi, "VLSI Fabrication Principles", John Willey & Sons
3. D. Nagchoudhuri, "Principles of Microelectronics Technology" PHI
4. Botkar, "Integrated Circuits", Khanna Publishers

BEC-40 PROJECT PART-I

Course category	:	Department Core (DC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, preliminary project report, effort and regularity and end semester presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of electronics system requirement.
2. Defining the right architecture for right application that meets cost and performance constraints.
3. Designing and verifying the functional model of electronics system.
4. Analysis of the design on simulation software.
5. Trouble shooting the design circuits using various trouble shooting equipments.

BEC-41	VLSI DESIGN	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	VLSI Technology (BEC-35)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand the fundamentals of CMOS VLSI and associated technologies.
2. Able to solve problems in the design of CMOS logic circuits, with particular reference to speed and power consumption.
3. Able to acquire hands-on skills of using CAD tools in VLSI design.
4. Able to appreciate the design process in VLSI through a mini-project on the design of a CMOS sub-system.
5. Able to explain basic operation principles of diodes and MOS transistors and their circuits level models
6. Able to design the fundamental blocks of a VLSI circuits, both by circuit schematic and physical layout
7. Able to analyze the influence of wires/interconnects on VLSI circuit performance.

Topics Covered	
UNIT-I	9
Introduction: Trends & Projections in VLSI Circuits, Flow diagram of VLSI Circuit Design and VLSI Design issues, Y-Chart; Electrical characterization of MOS transistor; Energy-band explanation for MOS structure, C-V characteristics of MOS Capacitor, Long-Channel and Short-Channel MOSFETs, Short-Channel effects, SPICE parameters of MOS transistor.	
UNIT-II	9
Basic VLSI design styles; NMOS, CMOS process flow; NMOS, PMOS and CMOS inverter design, noise margin, VTC curve, delay computations, power dissipation and scaling in CMOS circuits; combinational circuit design using NMOS, PMOS, CMOS & CMOS TG Circuits.	
UNIT-III	9
Stick Diagrams; Physical Design Rules; Layout Designing; Euler's Rule for VLSI Physical Design. Dynamic CMOS circuits; Basic Principles of pass transistor and transmission gate, CMOS Transmission-Gate and Pass-transistor logic circuits, Domino CMOS Logic, NORA CMOS Logic, Zipper CMOS circuits, Basic BiCMOS behavior	
UNIT-IV	9
Semiconductor Memories, ROM, DRAM and SRAM Cell Design; VLSI testing Introduction, Principle of testing, DC and AC parametric tests, fault modeling, Stuck-at-fault, fault equivalence, fault collapsing, fault dominance, fault simulation.	

EXPERIMENTS

A. Compulsory Experiments:

1. To design a CMOS inverter and perform the DC and transient analysis.
2. To design a CMOS inverter [W_p/L_p:W_n/L_n = 3:1] and analyze the effect of following parameters on average power:
   i. V_{DD} (Supply voltage)
   ii. C_L (Output load capacitance)
   iii. Frequency
3. To design XOR gate using transmission gate and perform its transient analysis.
4. To design a 2:1 Multiplexer and analyze its transient analysis.
5. Design the layout of XOR circuit using CMOS technology.
6. Write a Verilog HDL code to design 4 to 1 MUX and simulate on Questa simulator using Verilog test bench.
7. Write a Verilog HDL code for 16-Byte ROM memory and simulate on Questa simulator using Verilog test bench.

B. Optional Experiments:

8. To design CMOS based NAND gate and perform its transient analysis.
9. To design CMOS based NOR gate and perform its transient analysis.
10. To design XNOR gate using transmission gate and perform its transient analysis.
11. Design the layout of CMOS inverter using CMOS technology.
12. Write a Verilog HDL code to design 4 to 2 Encoder and simulate on Questa simulator using Verilog test bench.
13. Write a Verilog HDL code to design 4 to 2 Decoder and simulate on Questa simulator using Verilog test bench.
14. Write a Verilog HDL code for binary to Gray Code Conversion and simulate on Questa simulator using Verilog test bench.
15. Write a Verilog HDL code for 4-bit SIPO register and simulate on Questa simulator using Verilog test bench.

Books & References

1. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, Ed. 2003.
2. B.G. Streetman & S. Banerjee, "Solid State Electronic Devices", Pearson Education.
3. Neil H. Weste& David Harris, "CMOS VLSI Design: A Circuit and Systems Perspective", PHI.
4. J.M. Rabaey, A. Chandrakasan& B. Nikolic "Digital Integrated Circuits-A Design Perspective", Pearson.
5. Doughlas Pucknell & Kamran Eshragian, "Basic VLSI Design", PHI.

BEC-42 DIGITAL SIGNAL PROCESSING

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Signals and Systems (BEC-13)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1.	Able to analyze signals using the discrete Fourier transform (DFT).
2.	Understand circular convolution, its relationship to linear convolution, and how circular convolution can be achieved via the discrete Fourier transform.
3.	Able to understand the decimation in time and frequency FFT algorithms for efficient computation of the DFT.
4.	Able to understand the characteristics of IIR and FIR filters and learn the design of infinite and finite impulse response filters for filtering undesired signals.
5.	Able to implement digital filters in a variety of forms:-Direct form I &II, Parallel, Cascade and lattice structure.
6.	Able to understand the finite word length effects.

Topics Covered	
UNIT-I	9
Discrete Fourier Transforms: Definitions, Properties of the DFT, Circular Convolution, Linear Convolution **Fast Fourier Transform Algorithms:** Introduction, Decimation in Time (DIT) Algorithm, Computational Efficiency, Decimation in Frequency (DIF) Algorithm.	
UNIT-II	9
IIR Filter Design: Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF, BRF) filter design using frequency translation.	
UNIT-III	9
FIR Filter Design: Filter design using windowing (Rectangular Window, Hamming window, Hanning window, Blackman window, Kaiser window), Frequency sampling technique.	
UNIT-IV	9
Realization of Discrete Time Systems: FIR systems – Direct form, cascaded, parallel and lattice structures**,** IIR systems – Direct form, cascaded, parallel, lattice and lattice ladder structures **Finite Word length Effects:** Quantization effect in filter coefficients, round-off effect in digital filters	

Books & References

1. John G Prokias, Dimitris G Manolakis, "Digital Signal Processing", Pearson Education.
2. Oppenheim & Schafer, "Digital Signal Processing" PHI
3. Johnny R. Johnson, "Digital Signal Processing", PHI Learning Pvt Ltd., 2009.
4. S. Salivahanan, ""Digital Signal Processing" Mc Graw Hill Education

BEC-43 WIRELESS COMMUNICATION

Course category	:	Department Core (DC)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to understand the Infrastructure to develop mobile communication system:cellular Theory.
2. Able to understand the characteristics of different multiple access techniques in mobile/wireless communication.
3. Able to understand the need of coding, channel models, diversity, equalization and channel estimation techniques.Able to apply analytical and empirical models in the design of wireless links.
4. Able to understand the Wireless communication systems and standards: GSM,IS-95.
5. Able to understand the Ad Hoc networks and new trends in Mobile/wireless communication.
6. Able to understand the radio propagation over wireless channel and different limitations.
7. Able to apply analytical and empirical models in the design of wireless links.

Topics Covered

UNIT-I	9
Evolution of mobile communications, Mobile Radio System around the world, Types of Wireless communication System, Comparison of Common wireless system, Trend in Cellular radio and personal communication. Review of 2G, 3G, 4G and 5G wireless networks, Wireless Local Loop (WLL), Wireless Local Area network (WLAN), Bluetooth and Personal Area Networks.	
UNIT-II	9
Fundamentals of equalisation, Equalisers in communication receiver, Survey of equalisation techniques, linear equaliser, Algorithms for Adaptive Equalization, Diversity techniques, RAKE receiver with its applications. Characteristics of speech signals, quantisation techniques, vocoders, linear predictive coders, Multiple Access techniques for Wireless Communications.	
UNIT-III	9
Review of probability distribution function (PDF): Nakagami-m, Weibull distribution, Lognormal fading with application in realistic scenarios, Large scale path loss:-Free Space Propagation loss equation, Path-loss of NLOS and LOS systems, Reflection, Ray ground reflection model, Diffraction, Scattering, Link budget design, Max. Distance Coverage formula, Empirical formula for path loss, Indoor and outdoor propagation models, Small scale multipath propagation, Impulse model for multipath channel, Delay spread.	
UNIT-IV	
GSM system architecture, Radio interface, Protocols, Localization and calling, Handover, Authentication and security in GSM, GSM speech coding, Concept of spread spectrum, Architecture of IS-95 CDMA system, Air interface, CDMA forward channels, CDMA reverse channels, Soft handoff, CDMA features, Power control in CDMA, Performance of CDMA System, RAKE Receiver, CDMA2000 cellular technology, GPRS system architecture. Review of 4G and 5G networks and their comparative analysis, issues and challenges.	9

EXPERIMENTS

A. Compulsory Experiments

1. Indoor planning and find out the basic parameters like path loss, path gain, and received power.
2. Outdoor planning and find out Propagation path displays, Delay spread, Complex Impulse Response.
3. Co-Siting of WiMax Transmitters in Ottawa and predict path loss and other propagation characteristics in Ottawa.

4. Study the Signal coverage, multipath, and channel characteristics for wireless communications in complex urban environments.
5. To analyze the communication system and calculates SINR, throughput, theoretical capacity, and bit error rate (BER).
6. Set up and run a simulation using multiple-input multiple-out (MIMO) antennas in Wireless Insites X3D propagation model.
7. Throughput of a 5G New Radio FD-MIMO System in an Urban Area Using Custom Beam forming.

B. Optional Experiments

1. Maximum Permissible Exposure Prediction.
2. Study the outdoor propagation using hata model.
3. Simulation of Beam forming by Massive MIMO Antennas in Urban Environments.
4. Millimeter (mm) Wave Channel Modeling with Diffuse Scattering in an Office Environment.
5. Wi-Fi Performance Simulation in a house with Two Routers.
6. 5G mm Wave Channel Modeling with Diffuse Scattering in an Office Environment.
7. 5G Massive MIMO Outdoor Communications Analysis.
8. Modeling an Ad Hoc Network with Transceivers in an Urban Setting.

Books & References

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson, Second Edition.
2. T L Singal,"Wireless Communications ",McGraw Hill Publications.
3. Andrea Goldsmith, "Wireless Communications", Cambridge University press.
4. Andreas F. Molisch, "Wireless Communications", Wiley Student Edition.
5. S. Haykin& M. Moher, "Modern wireless communication", Pearson, 2005.

BEC-45	**INDUSTRIAL / PRACTICAL TRAINING**	
Course category	:	Audit Course (AC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 2
Number of Credits	:	1
Course Assessment methods	:	Continuous assessment through technical quality of the work, attendance, discipline, involvement and interest, project work, viva voce, project report and presentation
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1.Ability to demonstrate the use, interpretation and application of an appropriate international engineering standard in a specific situation.

2. Ability to analyse a given engineering problem, identify an appropriate problem solving methodology, implement the methodology and propose a meaningful solution.

3. Ability to apply prior acquired knowledge in problem solving.

4. Ability to identify sources of hazards, and assess/identify appropriate health & safety

measures.

5. Ability to work in a team.

6. Ability to take initiatives.

7. Ability to effectively communicate solution to problems (oral, visual, written).

8. Ability to manage a project within a given time frame.

9. Ability to adopt a factual approach to decision making.

10. Ability to take engineering decision.

BEC-50	**PROJECT PART-II**	
Course category	:	Department Core (DC)
Pre-requisite Subject	:	Project Part-I (BEC-40)
Contact hours/week	:	Lecture : 0, Tutorial : 0 , Practical: 10
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of electronics system requirement.
2. Defining the right architecture for right application that meets cost and performance constraints.
3. Designing and verifying the functional model of electronics system.
4. Analysis of the design on simulation software.
5. Trouble shooting the design circuits using various trouble shooting equipments.

BEC-51	**RADAR TECHNOLOGY**	
Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Electromagnetic Field Theory (BEC-14)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about Radar and Radar Equations.
2. Understanding the working principal of MTI and Pulse Doppler Radar.
3. Foster ability to work using Detection of Signals in Noise and Radio Direction Finding.
4. Foster ability to work using Instrument Landing System.
5. Acquired knowledge about Satellite Navigation System.

Topics Covered

UNIT-I	9
Introduction to Radar: Basic Radar, The Simply Form of the Radar Equations, Radar lock Diagram, Radar Frequencies, Applications of Radar. The Radar Equation: Detection of Signals in Noise, Receiver Noise and the Signal-to-Noise Ratio, Probabilities of detection and False Alarm, Integration of Radar Pulses, Radar Cross Section of Targets, Radar Cross-Section of Targets, Radar Cross-Section Fluctuations, Transmitter Power, Pulse Repetition Frequency, Antenna Parameters, System Losses, problems	
UNIT-II	9
MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay-Line Cancelers, Staggered Pulse Repetition Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.	
UNIT-III	9
Tracking Radar: Tracking with Radar, Mono pulse Tracking, Conical Scan and Sequential Lobing, Limitations to tracking Accuracy, Low- Angle Tracking, Tracking in Range, Other Tracking Radar Topics, Comparison of Trackers, Automatic Tracking with Surveillance Radars(ADT)	
UNIT-IV	9
Detection of Signals in Noise: Introduction, Detection Criteria, Detectors, Automatic Detection, Integrators, Constant-False-Alarm Rate Receivers. Information from Radar Signals: Basic Radar Measurements, Theoretical Accuracy of Radar Measurements, Ambiguity Diagram, Pulse Compression, Target Recognition, Land Clutter, Sea Clutter, Weather Clutter	

Books & References

1. Merrill I. Skolnik, "Introduction to Radar Systems" Third Edition._
2. J.C. Toomay , Paul J. Hannen " Principles of Radar" Third Edition.

BEC-52 BIOMEDICAL INSTRUMENTATION

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Fundamentals of Electronics Engineering (BEC-01)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will have a clear knowledge about human physiology system.
2. They will have knowledge of the principle operation and design and the

background knowledge of biomedical instruments and specific applications of biomedical engineering.

3. Learn several signals that can be measured from the human body. Specific examples include temperature, electrical, and pressure signals.
4. Review the cardiac, respiratory and neural physiological systems.
5. Study the designs of several instruments used to acquire signals from living systems. Examples of instruments studied include ECG, blood pressure monitors, spirometers, EEG, MRI, and ultrasound. Integrate information learned about biomedical signals, sensors and instrumentation design to create a design of your own.

Topics Covered

UNIT-I	9
Introduction: Specifications of bio-medical instrumentation system, Man-Instrumentation system Components, Problems encountered in measuring a living system. Basics of Anatomy and Physiology of the body. Bioelectric potentials: Resting and action potentials, propagation of action potential, The Physiological potentials – ECG, EEG, EMG, ERG, EOG and Evoked responses. Electrodes and Transducers: Electrode theory, Biopotential Electrodes – Surface electrodes, Needle electrodes, Microelectrodes, Biomedical Transducer.	
UNIT-II	9
Cardiovascular Measurements: Electrocardiography – ECG amplifiers, Electrodes and Leads, ECG –Single channel, Three channel, Vector Cardiographs, ECG System for Stresses testing, Holter recording, Blood pressure measurement, Heart sound measurement. Pacemakers and Defibrillators. Patient Care & Monitoring: Elements of intensive care monitoring, displays, diagnosis, Calibration & Reparability of patient monitoring equipment.	
UNIT-III	9
Respiratory system Measurements: Physiology of Respiratory system. Measurement of breathing mechanism – Spirometer. Respiratory Therapy equipments: Inhalators, Ventilators & Respirators, Humidifiers, and Nebulizers & Aspirators. Nervous System Measurements: Physiology of nervous system, Neuronal communication, Neuronal firing measurements.	
UNIT-IV	9
Ophthalmology Instruments: Electroretinogram, Electro - oculogram, Ophthalmoscope, Tonometer for eye pressure measurement. Diagnostic techniques: Ultrasonic diagnosis, Eco-cardiography, Eco-encephalography, Ophthalmic scans, X-ray & Radio-isotope diagnosis and therapy, CAT-Scan, Emission computerized tomography, MRI. Bio-telemetry: The components of a Bio-telemetry system, Implantable units, Telemetry for ECG measurements during exercise, for Emergency patient monitoring.	

Books & References

1. R. S. Khandpur, “Biomedical Instrumentation”, TMH
2. S. K. Venkata Ram, “Bio-Medical Electronics &Instrumentation (Revised)”, Galgotia.
3. J. G. Webster (editor), “Medical Instrumentation Application & Design”, 3rd Ed WILEY, India
4. Cromwell, “Biomedical Instrumentation and Measurements” PHI
5. J. G. Webster, “Bio- Instrumentation”, Wiley
6. S. Ananthi, “A Text Book of Medical Instruments”, New Age International
7. Carr & Brown, “Introduction to Biomedical Equipment Technology”, Pearson

BEC-53	**INFORMATION THEORY & CODING**

Course category	:	Programme Electives (PE1 & PE2)

Pre-requisite Subject	:	Digital Communication (BEC-31)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will be introduced to the basic notions of information and channel capacity.
2. Students will be introduced to convolutional and block codes, decoding techniques, and automatic repeat request (ARQ) schemes.
3. Students will be understood how error control coding techniques are applied in communication systems.
4. Students will understand the basic concepts of cryptography.

Topics Covered

UNIT-I	9
Information Theory Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding - Joint and conditional entropies, Mutual information - Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.	
UNIT-II	9
Source Coding: Text, Audio And Speech Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 - Speech: Channel Vocoder, Linear Predictive Coding.	
UNIT-III	9
Error Control Coding: Block Codes Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding - Single parity codes, Hamming codes, Repetition codes - Linear block codes, Cyclic codes - Syndrome calculation, Encoder and decoder – CRC.	
UNIT-IV	9
Error Control Coding: Convolutional Codes Convolutional codes – code tree, trellis, state diagram - Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding.	

Books & References

1. R Bose, “Information Theory, Coding and Cryptography”, TMH 2007.
2. Fred Halsall, “Multimedia Communications: Applications, Networks, Protocols and Standards”, Perason Education Asia, 2002.
3. K Sayood, “Introduction to Data Compression” 3/e, Elsevier 2006
4. S Gravano, “Introduction to Error Control Codes”, Oxford University Press 2007.
5. Amitabh Bhattacharya, “Digital Communication”, TMH 2006.

BEC-54	**ADVANCED SEMICONDUCTOR DEVICES**

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Solid State Devices & Circuits (BEC-15)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students study the basic of different kinds of modern semiconductor devices.
2. Ability to understand the basic operation and working of different diodes like PIN, Varactor diode etc. To understand the high frequency application of diodes.
3. To understand and use of the device models to explain and calculate the characteristics of the field effect transistors.
4. To be able to understand and analyze the V-I characteristics of different high power devices.
5. Understand the operation of charge-transfer devices and charge storage devices.

Topics Covered

UNIT-I	9
Review of Fundamentals of Semiconductors: Semiconductor Materials and their properties, carrier transport by drift and diffusion, electron - hole pair generation and recombination: band to band (direct and indirect band gap transitions), continuity equations.	
UNIT-II	9
Junctions and Interfaces: Description of p-n junction, The Abrupt Junction, The linearly graded Junction, Description of Breakdown Mechanism, Zener and Avalanche Breakdown in p-n Junction. Special purpose diodes: P-I-N diode, IMPATT diode, TRAPATT diode, BARITT diode, Photo detectors: photoconductor, photodiodes, avalanche photodiode, phototransistor, charge-coupled device (CCD).	
UNIT-III	9
Majority Carrier Diodes: The Tunnel Diode, The Schottkey Barrier Diode, Ohmic Contacts Heterojunctions. Optoelectronic Devices: The Solar Cell:generation of photo voltage, light generated current, I-V equation, solar cell characteristics, parameters of solar cells, Relation of V_{oc} and E_g, light emitting diodes, semiconductor lasers.	
UNIT-IV	9
Metal Semiconductor Field Effect Transistors: Basic Types of MESFETs, Models for I-V Characteristics of Short – Channel MESFETs, tunnelling field-effect transistor (TFET), thin film transistor (TFT), JFET, high electron-mobility transistor (HEMT), modulation-doped FET (MODFET), single-electron transistor, floating gate MOSFET.	

Books & References

1. M.S. Tyagi, “Introduction To Semiconductor Materials And Devices”, John Willy-India Pvt. Ltd.
2. S. M. Sze, “Physics of Semiconductor Devices”, 2nd Edition, John Willy-India Pvt. Ltd.
3. B. G. Streetman and S. Banerjee, “Solid state electronics devices”, 5th Edition, PHI.
4. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, 2nd Edition

Prentice Hall of India, 2011.

BEC-55	OPTOELECTRONICS

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Solid State Devices & Circuits (BEC-15)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand fundamental properties of light and operation principles of basic optical components.
2. Demonstrate a mastery of basic mechanisms of light generation (including lasers) through detailed understanding and analysis of operation principles, characteristics, design architectures and trade-offs of semiconductor lasers.
3. Understand and compare operation principles, characteristics, design architectures and trade-offs of optical detectors and modulators of light.
4. Understand basic system design of fiber optic communication link and fundamental theory of fiber optics.

Topics Covered

UNIT-I	9
Nature and Properties of Light Wave nature of light, polarization, reflection, refraction, diffraction, Interference, transmission and absorption of light radiation, Refractive index, total internal reflection, light sources, Units of light.	
UNIT-II	9
Review of Semiconductor Devices Introduction to optoelectronics devices , Energy bands in solids, the E-k diagram, , elemental and compound Semiconductor, Semiconductor optoelectronic materials, effect of temperature and pressure on bandgap, Bandgap modification, Heterostructures and Quantum Wells.	
UNIT-III	9
Display Devices Introduction, Photo Luminescence, Cathode Luminescence, Electro Luminescence, Injection Luminescence, Injection Luminescence, working principle and application of LED, Display devices, Liquid Crystal Display, Plasma Displays, Numeric Displays.	
UNIT-IV	9
Industrial Applications of Optoelectronics Gas and solid state LASERs, Photo detectors types and applications, Solar cell, Fiber optic sensors. Optoelectronic integrated Circuits (OEICs): Need for Hybrid and monolithic integration, OEIC transmitter and receivers.	

Books & References

1. Semiconductor Optoelectronic Devices, Pallab Bhattarchrya, Prentice Hall Publication

2. Optoelectronics An Introduction, J.Wilson-J.F.B. Hawkes
3. Optical Engineering Fundamentals, B.H. Walker, PHI.
4. Electro-Optical Instrumentation Sensing and Measuring with Lasers, Silvano Donati, Pearson.
5. Fiber optics and Optoelectronics, R.P. Khare, Oxford Press

BEC-56	**ELECTRONICS SWITCHING**	
Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire knowledge about switching theory and algebra.
2. Ability to learn and design sequential circuits.
3. Acquire knowledge and ability to analyze threshold gates sand their synthesis.
4. Foster ability to use PLDs and PLAs.
5. Acquired knowledge about and ability to design ASM and FSM.
6. Learn about various fault tolerance and diagnosis techniques.

Topics Covered

UNIT-I	9
Evolution of Switching systems: Introduction: Message switching, circuits switching, functions of a switching system, register-translator-senders, distribution frames, crossbarswitch, a general trunking, electronic switching, Reed electronic system, digital switching systems.	
UNIT-II	9
Digital switching: Switching functions, space division switching, Time division switching, two dimensional switching, Digital cross connect systems, digital switching in analog environment. Telecom Traffic Engineering: Network traffic load and parameters, grade of service and blocking probability, modelling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, Delay systems.	
UNIT-III	9
Control of Switching Systems: Introduction, Call processing functions; common control, Reliability availability and security; Stored program control. Signalling: Introduction, Customer line signalling, AF junctions and trunk circuits, FDM carrier systems, PCM and inter register signalling, Common channel signalling principles, CCITT signalling system No. 6 and 7, Digital customer line signalling.	
UNIT-IV	9
Packet Switching: Packets formats, statistical multiplexing, routing control, dynamic, virtual path circuit and fixed path routing, flow control, X.25 protocol, frame relay, TCP/IP, ATM cell, ATM service categories, ATM switching, ATM memory switch, pace memory switch, memory-space, memory-space-memory switch, Banyan network switch.	

Books & References

1. ThiagarajanViswanathan, "Telecommunication switching System and networks", PHI.
2. J.E. Flood, "Telecommunication switching, Traffic and Networks", Pearson education.
3. J.C. Bellamy, "Digital Telephony", John Wiley, 3e.

BEC-57 DIGITAL SYSTEM DESIGN USING VHDL

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	Digital Electronics & Circuits (BEC-12)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Model digital systems in VHDL at different levels of abstraction.
2. Partition a digital system into different subsystems.
3. Simulate and verify a design.
4. Transfer a design from a version possible to simulate to a version possible to synthesize
5. Use modern software tools for digital design in VHDL.
6. Describe principal parts in programmable circuits (PLD, FPGA, ASIC) and describe how small designs are implemented in programmable circuits.

Topics Covered

UNIT-I	9
Introduction to VHDL, reserve words, structures, modeling, objects, data type and operators, sequential statements and processes, sequential modeling and attributes, conditional assignment, concatenation and case, array loops and assert statements, subprograms.	
UNIT-II	9
Digital System Design Automation– Abstraction Levels, System level design flow, RTL design flow, VHDL. RTL Design with VHDL – Basic structures of VHDL, Combinational circuits, Sequential circuits, Writing Test benches, Synthesis issues, VHDL Essential Terminologies VHDL Constructs for Structures and Hierarchy Descriptions – Basic Components, Component Instantiations, Iterative networks, Binding Alternatives, Association methods, generic Parameters, Design Configuration.	
UNIT-III	9
Concurrent Constructs for RT level Descriptions – Concurrent Signal Assignments, Guarded signal assignment Sequential Constructs for RT level Descriptions – Process Statement, Sequential WAIT statement, VHDL Subprograms, VHDL library Structure,	

Packaging Utilities and Components, Sequential Statements. VHDL language Utilities - Type Declarations and Usage, VHDL Operators, Operator and Subprogram overloading, Other TYPES and TYPE– related issues, Predefined Attributes	
UNIT-IV	9
VHDL Signal Model – Characterizing hardware languages, Signal Assignments, Concurrent and Sequential Assignments, Multiple Concurrent Drivers Standard Resolution	
EXPERIMENTS 1. Design all gates using VHDL. 2. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. Half adder b. Full adder 3. Write VHDL programs for the following circuits, check the wave forms and the hardware generated a. Multiplexer b. Demultiplexer 4. Write VHDL program for encoder and check the wave forms and the hardware generated. 5. Write a VHDL program for a decoder and check the wave forms and the hardware generated. 6. Write a VHDL program for a Down counter and check the wave forms and the hardware generated. 7. Write a VHDL program for a BCD to GRAY code converter and check the wave forms and the hardware generated. 8. Write a VHDL program for a T FLIP-FLOP and check the wave forms and the hardware generated.	

Books & References

1. The 8051 Microcontrollers and Embedded Systems: Muhammed Ali Mazidi
2. The 8051 Microcontrollers Architecture, Programming & Applications Kenneth J. Ayala
3. Design with PIC Microcontroller: John Petman

BEC-58 FUNDAMENTAL OF SATELLITE COMMUNICATION

Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Nil
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Revised the fundamentals of orbital mechanics, identify the characteristics of common orbits used by communications and other satellites.
2. Identify the Different elements used to design the earth station for satellite communication.
3. Identify the Different elements used to design the space station for satellite communication.

4. Calculate an accurate link budget design for the uplink and downlink in satellite communications link.	
Topics Covered	
UNIT-I	9
Evolution of satellite communication, Elements of Satellite Communication, Kepler laws, Orbital elements, Orbital perturbations, Apogee perigee heights, Inclines orbits, Sun synchronous orbits, Geo stationary orbits, Limits of visibility, Sun transit outage, polar Mount antenna, Antenna Look angles, Launching orbits, Low earth orbits, Medium orbits, satellite antenna.	
UNIT-II	9
Earth segment: Receive-Only Home TV Systems, Master Antenna TV System, Transmit-Receive Earth Stations, Introduction to GPS and VSAT system, GPS and VSAT Receiver Operation.	
UNIT-III	9
Space segment: power supply subsystem, attitude control, station keeping, thermal control, TT & C Subsystem, Transponders, Antenna subsystem.	
UNIT-IV	9
Satellite link design: basic transmission theory, system noise temperature and G/T ratio, Uplink and downlink design, design for specified C/N, Input and Output back Off, Propagation effects and their impact on satellite-earth links: attenuation and depolarization, atmospheric absorption, rain, cloud and ice effects etc.	
Books & References	
1. B. Pratt, A. Bostian, "Satellite Communications", Wiley India. 2. D. Roddy, "Satellite Communications", TMH, 4th Ed. 3. S. D. Ilcev, "Global Mobile Satellite Communication", Springer. 4. R. Pandya, "Mobile and Personal Communication Systems and Services ", PHI.	

BEC-61	**MICROCONTROLLER & EMBEDDED SYSTEMS**	
Course category	:	Programme Electives (PE1 & PE2)
Pre-requisite Subject	:	Digital Electronics & Circuits (BEC-12), Microprocessors & Application (BEC-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To develop in depth understanding on operation of microprocessor and microcontroller.
2. Understand assembly language program for 8051.
3. Comparative study of higher versions of microcontroller e.g. PIC.
4. Acquired knowledge about Microcontrollers and its need.
5. Ability to identify basic architecture of different Microcontrollers.

Topics Covered	
UNIT-I	9

Introduction to Microcontrollers and Embedded Processors – Microcontrollers survey-four bit, eight bit, sixteen bit, thirty two bit Microcontrollers --Comparing Microprocessors and Microcontrollers-Overview of the 8051 family.	
UNIT-II	9
The 8051 Architecture- Hardware- Oscillator and clock-program counter –data pointer-registers-stack and stack pointer-special function registers- -memory organization-program memory-data memory -Input / Output Ports –External memory counter and timer-serial data Input / output-Interrupts.	
UNIT-III	9
8051 Assembly Language Programming-Structure of Assembly language Assembling and running an 8051 program- Addressing modes-Accessing memory using various addressing modes-Instruction set- Arithmetic operations and Programs-Logical operations and Programs -Jump and Call instructions and Programs -I /O Pot Programs - Single bit instructions and Programs –Timer and counter - and Programs.	
UNIT-IV	9
8051 Serial Communication-Connection to RS-232- Serial Communication Programming-Interrupts Programming Microcontroller Interfacing-Key Board- Displays- Pulse Measurement - D/A and A/D conversion-Stepper Motor Basic concept of PIC microcontroller –Microcontroller Architecture – PIC16F Family.	

Books & References

1. The 8051 Microcontrollers and Embedded Systems: Muhammed Ali Mazidi
2. The 8051 Microcontrollers Architecture, Programming & Applications Kenneth J. Ayala
3. Design with PIC Microcontroller: John Petman

BEC-62 OPTICAL COMMUNICATION

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	Principles of Communication (BEC-28)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Fundamentals, advantages and advances in optical communication system.
2. Types, basic properties and transmission characteristic of optical fibers.
3. Knowledge of working and analysis of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system.
4. Configuration and architecture of coherent optical communication, advanced system techniques and nonlinear optical effects and their applications.

Topics Covered

UNIT-I	9
Overview of optical fiber communication- The general system, advantages of optical fiber communications. Optical fiber wave guides- Introduction, Ray theory transmission, Optical fiber Modes and configuration, Mode theory for circular Waveguides, Step Index fibers, Graded Index fibers. Single mode fibers- Cut off wavelength, Mode Field Diameter, Effective Refractive Index. Fiber Material and its Fabrication Techniques.	
UNIT-II	9
Signal distortion in optical fibers- Attenuation, Absorption, Scattering and Bending losses, Core and Cladding losses. Information capacity determination, Group delay, Attenuation Measurements Techniques, Types of Dispersion - Material dispersion, Wave-guide dispersion, Polarization mode dispersion, and Intermodal dispersion. Pulse broadening. Overall fiber dispersion in Multi mode and Single mode fibers, Fiber dispersion measurement techniques, Non linear effects. Optical fiber Connectors: Joints, Couplers and Isolators.	
UNIT-III	9
Optical sources- LEDs, Structures, Materials, Quantum efficiency, Power, Modulation, Power bandwidth product. Laser Diodes- Basic concepts, Classifications, Semiconductor injection Laser Modes, Threshold conditions, External quantum efficiency, Laser diode rateequations, resonant frequencies, reliability of LED & ILD	
UNIT-IV	9
Source to fiber power launching - Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling. Optical detectors- Physical principles of PIN and APD, Detector response time, Temperature effect on Avalanche gain, Comparison of Photo detectors. Optical receiver operation- Fundamental receiver operation, Digital signal transmission, error sources, Receiver configuration, Digital receiver performance, Probability of error, Quantum limit, Analog receivers	

EXPERIMENTS

A. Compulsory Experiments

1. To setting up fiber optic analog link.
2. To measurement and study of losses in optical fiber.
3. Study and measurement of numerical aperture of optical fiber.
4. Measurement of Intensity modulation techniques using analog input signal.
5. Study of Intensity modulation techniques using digital input signal.
6. To measure propagation loss in optical fiber using optical power meter.
7. Study of bending loss.

B. Optional Experiments

1. To Study of pulse width modulation and demodulation.
2. Study and measure characteristics of fiber optic LED and photo detector.
3. Setting a fiber optic voice link.

Books & References

1. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3e, ,2004.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3e, 2010.
3. Gerd Keiser, “Optical Fiber Communications”, TMH, 4e
4. Joseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4e, 2004.

BEC-63	**DSP ARCHITECTURE & APPLICATIONS**

Course category	:	Programme Electives (PE3)

Pre-requisite Subjects	:	Digital Signal Processing (BEC-42) Microprocessors & Application (BEC-32)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Comprehends theknowledge& concepts of digital signal processing techniques.
2. Acquire knowledge of DSP computational building blocks and knows how to achieve speed in DSP architecture or processor.
3. Develop basic DSP algorithms using DSP processors.
4. Acquire knowledge about various addressing modes of DSP and are able to program DSP processor.
5. Discuss about interfacing of serial and parallel communication devices.

Topics Covered

UNIT-I	9
Introduction To Digital Signal Processing: Introduction, A Digital Signal-Processing System, The Sampling Process, Discrete Time Sequences, Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear Time-Invariant Systems, Digital Filters, Decimation and Interpolation.	
UNIT-II	9
Architectures For Programmable Digital Signal Processors: Introduction, Basic Architectural Features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Features for External Interfacing.	
UNIT-III	9
Programmable Digital Signal Processors: Introduction, Commercial Digital Signal-processing Devices, Data Addressing Modes of TMS32OC54xx., Memory Space of TMS32OC54xx Processors, Program Control. Detail Study of TMS320C54X & 54xx Instructions and Programming, On-Chip peripherals, Interrupts of TMS32OC54XX Processors, Pipeline Operation of TMS32OC54xx Processor.	
UNIT-IV	9
Implementation of Basic DSP And FFT Algorithms: Introduction, the Q-notation, FIR Filters, IIR Filters, Interpolation and Decimation Filters (one example in each case). Introduction, an FFT Algorithm for DFT Computation, Overflow and Scaling, BitReversed Index Generation & Implementation on the TMS32OC54xx. **Applications of DSP Using MATLAB:** Mobile communication, medical, image processing, Acoustic Noise Canceller, Dynamic range compression, LPC analysis and synthesis, SSB modulation, Radar tracking implementation	
EXPERIMENTS	

1. Numbers representation. Fixed Point Representation (Qx, IQ Format).
2. Effect of sampling rate on waveform generation using DSP processor(Using CCS)
3. DFT computation using DSP processor
4. FIR filter design using MATLAB and find finite word length effect
5. FIR filter design using DSP processor
6. IIR filter design using MATLAB and find finite word length effect
7. IIR filter design using DSP processor
8. Analysis of speech signal
9. Application Development using CCS. Examples Signals Acquisition, DTMF tone detection techniques and the Goertzel algorithm, A GMSK Modulator Implementation

Books & References

1. Digital Signal Processing: A practical approach, Ifeachor E. C., Jervis B. W Pearson-Education, PHI,2002
2. "Digital Signal Processors", B Venkataramani and M Bhaskar TMH, 2002
3. "Architectures for Digital Signal Processing", Peter Pirsch John Weily, 2007
4. "Digital Signal Processing", S.kmitra,,TMH, 2002
5. Applications to DSP Using Matlab-Proakis
5. "Digital Signal Processing", Avatar Singh and S. Srinivasan, Thomson Learning, 2004

BEC-64 ANTENNA DESIGN

Course category	:	Programme Electives (PE3)
Pre-requisite Subject	:	Electromagnetic Field Theory (BME-29)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Three Minor tests and One Major Theory & Practical Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the radiation mechanism of antenna and also to learn about the basic parameters of antennas.
2. To have insight into the derivation of field quantities of various antennas and there by deducing the other quantities like gain, directivity, impedance etc.
3. To design, development and fabrication of various types antennas and also to explore array concepts.
4. To understand the features of antennas test range (ATR) to perform various measurements on different antennas.
5. To understand the wave propagation over ground and through different layers of atmosphere.

Topics Covered

UNIT-I	
Fundamental Concepts: Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.	9

UNIT-II	
Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. Aperture Antennas: Huygens' principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Fourier transform method in aperture antenna theory	9
UNIT-III	
Horn and Reflector Antennas: Radiation from sectoral and pyramidal horns, design concepts, prime-focus parabolic reflector and cassegrain antennas. Microstrip Antennas: Basic characteristics, feeding methods, methods of analysis, design of rectangular and circular patch antennas.	9
UNIT-IV	
Antenna Arrays: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, synthesis of antenna arrays using Schelkunoff polynomial method, Fourier transform method, and Woodward-Lawson method.	9

EXPERIMENTS

1. To verify the inverse square law of propagation: to measure the variation of the strengthof radiated wave, with distance from transmitting antenna.
2. Measure parameter of dipole/folded dipole antenna:
   a) To plot the radiation pattern of the dipole antenna in azimuth and elevation planes onlog and linear scales on polar and Cartesian plots.
   b) To measure the beam width(-3dB), front–to-back ratio, side lobe level & its angularposition, plane of polarization &directivity and gain of the dipole antenna.
3. To demonstrate that the transmitting and receiving radiation patterns of an antenna areequal and hence confirm the reciprocity theorem of antenna.
4. To study the characteristics of Broadside array.
5. To measure various parameters of log periodic antenna using radiation pattern.
6. To measure various parameter of slotted antenna using radiation patterns.
7. To study the frequency dependant and independent antenna.
8. To study the characteristic features of endfire array.
9. To study the characteristic features of microstrip antenna.
10. To measure the phenomenon of linear and circular polarization of antennas.
11. To study an antenna design simulation software.

Books & References

1. Balanis, C.A., "Antenna Theory and Design", 3e., John Wiley & Sons.
2. Jordan, E.C. and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", 2e, Prentice-Hall of India.
3. Stutzman, W.L. and Thiele, H.A., "Antenna Theory and Design", 2e, John Wiley & Sons.
4. Elliot, R.S., "Antenna Theory and Design", Revised edition, WileyIEEE Press.

BEC-65 DIGITAL IMAGE PROCESSING

Course category	:	Programme Electives (PE4)
Pre-requisite Subjects	:	Signals & Systems (BEC-13) Digital Signal Processing (BEC-42)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination

Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquired knowledge about discrete-time sequences, concept of energy and power, periodicity.
2. Acquired knowledge DFT and FFT.
3. Ability to design linear digital filters both FIR and IIR using different techniques and their associated structures.
4. Ability to understand the concept of linear prediction and estimation.
5. Ability to understand the concept of Multi-rate signal processing and sample rate conversion.
6. Acquired knowledge about time-frequency analysis.

Topics Covered

UNIT-I	9
Introduction Fundamental steps in DIP, elements of DIP, Simple image model, sampling & quantization, basic relationships between pixels, colour image model. Image Transforms: One-dimensional & two-dimensional DFT, cosine, sine, Hadamard, Haar, and Slant & KL transforms. Image Enhancement: Introduction, point operations, histogram modelling, spatial operations, Transform operations.	
UNIT-II	9
Image Restoration Introduction, image observation models, Inverse & Wiener filtering, difference between enhancement & restoration Restoration-spatial filtering, Noise reduction in frequency domain.	
UNIT-III	9
Image Compression Introduction, Pixel coding, Predictive coding, Transform coding, Inter-frame coding	
UNIT-IV	9
Image Segmentation Introduction, Spatial feature extraction, Transforms features, Edge detection, Boundary extraction, Segmentation techniques.	

Books & References

1. Rafael C. Gonzalez Richard E Woods, "Digital Image Processing", Pearson, 3e, 2009.
2. Anil K Jain, "Fundamentals of Digital Image Processing", PHI.

BEC-66 ATM NETWORKS AND B-ISDN

Course category	:	Programme Electives (PE4)
Pre-requisite Subject	:	Data Communication Networks (BEC-33)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basics of network protocols, access control, data link control, ATM, TCP/IP.
2. Understand the tradeoffs involved in network design in a variety of environments- LAN and WAN, diverse link rates, and varied error and delay conditions.
3. Understand the layered structure of protocols.
4. Understand the importance of standards.
5. Understand various concepts of broadband networks and subsequently conduct research in this field.

Topics Covered	
UNIT-I	9
ATM ATM standards, Terms and Concepts, B-ISDN Protocol Architecture, Physical Layer, ATM Layer, AAL, ATM services, ATM switches.	
UNIT-II	9
Overview of ISDN ISDN Channels, Access interface, functional devices and reference, services, Protocol structure, D-Channel Layer 3 Protocols, Numbering and addressing, ISDN Products.	
UNIT-III	9
Broadband networks & Frame relay Broadband networks: Need, Fast packet switching, Frame relay, Cell relay & ATM, FDDI, SMDS. Frame Relay: Basic Definition, Protocol Architecture, Permanent and switched VC, Frame relay standards, Multicast services.	
UNIT-IV	9
SMDS Overview SMDS Interface & Services. ISDN, B-ISDN and Internet Protocols.	

Books & References

1. Kessler &Southeick: "ISDN" – McGraw Hill, 3e, 1996.
2. William Stallings: "ISDN" – Pearson Education

BEC-67 RF ICs

Course category	:	Programme Electives (PE4)
Pre-requisite Subject	:	Analog Integrated Circuits (BEC-27)
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Possess a basic knowledge of RF systems used in telecommunication industries.
2. Understand the concepts of various components of circuits used in RF systems.
3. Understand the methodology of using analog and digital modulation of an RF carrier.

4. Understand the basic RF characterization utilizing gain, bandwidth, noise, phase noise, S parameters.

5. Design LNAs, power amplifiers, mixer, multipliers, oscillators used in RF systems.

6. Design basic RF circuits at the chip level.

Topics Covered

UNIT-I	9
Introduction to RF and Wireless Technology: Complexity comparison, Design bottle necks, Applications, Analog and digital systems, Choice of Technology. Basic concepts in RF Design: Nonlinearity and time variance, ISI, Random process and noise, sensitivity and dynamic range, passive impedance transformation.	
UNIT-II	9
Low Noise Amplifiers: Gain, Linearity, stability and bandwidth considerations; LNA Topologies; Non-linearities calculation	
UNIT-III	9
Mixers, Oscillators and Frequency synthesizers: performance parameters, noise figure, down conversion and up conversion mixers	
UNIT-IV	9
Power Amplifiers: General considerations, linear and nonlinear PAs, classification, High Frequency power amplifier, large signal impedance matching, linearization techniques.	

Books & References

1. Behzad Razavi, RF Microelectronics Prentice Hall of India, 2001.
2. Thomas H. Lee, The Design of CMOS Radio Integrated Circuits, Cambridge University Press.

BEC-68 NEURAL NETWORKS

Course category	:	Programme Electives (PE4)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture : 3, Tutorial : 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Three Minor tests and One Major Theory Examination
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To study the role of neural networks in engineering, artificial intelligence, and cognitive modelling.

2. To study the learning process of the neural networks of increasing complexity and learning the generalization theory.

3. To study the single-layer perceptron and multi-layered architecture of the neural networks.

4. Ability to apply neural networks to particular applications, and to know what steps to take to improve the performance.

Topics Covered

UNIT-I	
Introduction to neural networks, human brain, biological neuron, models of neuron, signal flow graph of neuron, feedback, network architecture, knowledge representation, Artificial intelligence and neural networks.	9
UNIT-II	
Learning Process: Error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, learning with and without teacher, learning tasks, memory and adaptation. Artificial neurons, Neural networks and architectures, neuron signal function, mathematical preliminaries, Feed forward & feedback architecture.	9
UNIT-III	
Introduction to Rosenblatt's perceptron, perceptron learning algorithm, perceptron convergence theorem, Single-Layer Perceptron classifiers, LMS learning Algorithm, Back propagation and other learning algorithms Multi-layered architecture, structure growing algorithms, applications of feed forward neural networks.	9
UNIT-IV	
Applications of Neural Algorithms and Systems: Linear Programming Modelling Network, Character Recognition Networks, Neural Networks Control Applications, Networks for Robot Kinematics, Neural Networks for nanotechnology applications.	9
Books & References	
1. Kumar Satish, "Neural Networks", TMH 2. Simon Haykin, "Neural Networks", PHI 3. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publishers, 3e.	