EVALUATION SCHEME

B.TECH. ELECTRONICS ENGINEERING, B.TECH. ELECTRONICS & COMMUNICATION ENGINEERING, B.TECH. ELECTRONICS & TELECOMMUNICATION ENGINEERING

YEAR 3rd/ SEMESTER V

Sr. No.	Sub Code	Subject Name	L-T-P	Th/Lab Marks	Sessional		Total	Credit
				ESE	CT	TA		
1	RAS501	Managerial Economics	3--0--0	70	20	10	100	3
2	RAS502 /RUC501	Sociology/Cyber Security	3--0--0	70	20	10	100	3
3	REC501A	Integrated Circuits	3--0--0	70	20	10	100	3
4	REC502	Principles of Communication	3--1--0	70	20	10	100	4
5	REC503	Digital Signal Processing	3--0--0	70	20	10	100	3
6	REC051-055	Deptt. Elective Course 1	3--1--0	70	20	10	100	4
7	REC551	Integrated Circuits Lab	0--0--2	50		50	100	1
8	REC552	Communication Lab – I	0--0--2	50		50	100	1
9	REC553	Digital Signal Processing Lab	0--0--2	50		50	100	1
10	REC554	CAD of Electronics Lab-I	0--0--2	50		50	100	1
	TOTAL			620	120	260	1000	24

DEPTT ELECTIVE COURSE–1

1. **REC051 - Antenna & wave propagation**
2. **REC052 - Computer Architecture and Organization**
3. **REC053- Real Time Systems**
4. **REC054- Artificial Neural Networks**
5. **REC055- Advance Semiconductor devices**

EVALUATION SCHEME

B.Tech. Electronics Engineering, B.Tech. Electronics & Communication Engineering, B.Tech. Electronics & Telecommunication Engineering

YEAR 3rd/ SEMESTER VI

Sr. No	Sub Code	Subject Name	L-T-P	Th/LAB Marks	Sessional		Total	Credit
				ESE	CT	TA		
1	RAS601	Industrial Management	3--0--0	70	20	10	100	3
2	RAS602 / RUC601	Sociology /Cyber Security	3--0--0	70	20	10	100	3
3	RIC603	Control System I	3--0--0	70	20	10	100	3
4	REC601	Microwave Engineering	3--1--0	70	20	10	100	4
5	REC602	Digital Communication	3--0--0	70	20	10	100	3
6	REC061 - 065	Deptt. Elective Course 2	3--1--0	70	20	10	100	4
7	REC-651	Microwave Engg Lab	0--0--2	50		50	100	1
8	REC-652	Communication Lab- II	0--0--2	50		50	100	1
9	RIC-653	Control System Lab-I	0--0--2	50		50	100	1
10	RIC-651	Microcontrollers For Embedded Systems Lab	0--0--2	50		50	100	1
	TOTAL			620	120	260	1000	24

DEPTT ELECTIVE COURSE–2

1. **REC061 - Industrial Electronics**
2. **REC062 - Microcontroller for Embedded Systems**
3. **REC063 - Analog Signal Processing**
4. **REC064 - Advance Digital Design Using Verilog**
5. **REC065- RADAR Engineering**

REC501	INTEGRATED CIRCUITS	
Unit	Topic	Lectures
I	**Analog Integrated circuit Design: an overview:** Current Mirrors using BJT and MOSFETs, Simple current Mirror, Base current compensated current Mirror, Wilson and Improved Wilson Current Mirrors, Widlar Current source and Cascode current Mirror **The 741 IC Op-Amp:** Bias circuit, short circuit protection circuitry, the input stage, the second stage, the output stage, and device parameters; D**C** Analysis of 741: Small Signal Analysis of input stage, the second stage, the output stage; Gain, Frequency Response of 741; a Simplified Model, Slew Rate, Relationship Between ft and SR	10
II	**Linear Applications of IC op-amps:** An Overview of Op-Amp (ideal and non-ideal) based Circuits V-I and I-V converters, generalized Impedance converter, simulation of inductors. **Filters:** First and second order LP, HP, BP BS and All pass active filters, KHN.	8
III	**Digital Integrated Circuit Design- An Overview**: CMOS Logic Gate Circuits**:** Basic Structure CMOS realization of Inverters, AND, OR, NAND and NOR Gates **Latches and Flip flops:** The Latch, The SR Flip-flop, CMOS Implementation of SR Flip- flops, A Simpler CMOS Implementation of the Clocked SR Flip-flop, D Flip-flop Circuits.	8
IV	**Non-Linear applications of IC Op-amps:** Log–Anti Log Amplifiers, Precision Rectifiers, Peak Detectors, Simple and Hold Circuits, AnalogMultipliersand their applications. Op- amp as a comparator, Zero crossing detector, Schmitt Trigger, Astable multi vibrator, Mono stable multi vibrator, Generation of Triangular Waveforms	7
V	**D/A and A/D converters Integrated Circuit Timer:** The 555 Circuit, Implementing a Mono stable Multi-vibrator Using the 555 IC, Astable Multi vibrator Using the 555 IC. **Phase locked loops (PLL):** Ex-OR Gates and multipliers as phase detectors**,** Block Diagram of IC PLL, Working of PLL and Applications of PLL.	7

Text Book:

1. Sedra and Smith, "Microelectronic Circuits", 6th Edition, Oxford University Press.
2. Michael Jacob, "Applications and Design with Analog Integrated Circuits", PHI, 2nd Edition.
3. A. K. Maini, Analog Circuits, Khanna Publishing House, Delhi.

Reference Books:

1. Jacob Millman and Arvin Grabel, "Microelectronics", 2nd Edition, Tata McGraw Hill.
2. BehzadRazavi, "Fundamentals of Microelectronics", 2nd Edition, Wiley.
3. Mark N. Horenstein, "Microelectronic Circuits and Devices", PHI.
4. Paul R. Gray, Paul J. Hurst, Stephen H. Lewis and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", Wiley.
5. Data Sheet: http://www.ti.com/lit/ds/symlink/tl082.pdf
6. Application Note: http://www.ti.com/lit/an/sloa020a/sloa020a.pdf
7. MPY634 Data Sheet: http://www.ti.com/lit/ds/symlink/mpy634.pdf
8. Application Note: http://www.ti.com/lit/an/sbfa006/sbfa006.pdf
9. ASLK Pro Manual: ASLK Manual

REC502	PRINCIPLES OF COMMUNICATION	
Unit	Topic	Lectures
I	Introduction: Overview of Communication system, Communication channels, Need for modulation, Baseband and Pass band signals, Amplitude Modulation: Double sideband with Carrier (DSB-C), Double side band without Carrier DSB-SC, Single Side Band Modulation SSB, Modulators and Demodulators, Vestigial Side Band (VSB), Quadrature Amplitude Modulator, Radio Transmitter and Receiver	10
II	Angle Modulation, Tone Modulated FM Signal, Arbitrary Modulated FM Signal, Bandwidth of FM Signals using Bessel's Function, FM Modulators and Demodulators, Approximately Compatible SSB Systems, Stereophonic FM Broadcasting.	7
III	Pulse Modulation, Digital Transmission of Analog Signals: Sampling Theorem and its applications, Pulse Amplitude Modulation (PAM), Pulse Width Modulation, Pulse Position Modulation, Their generation and Demodulation, Digital Representation of Analog Signals Pulse Code Modulation (PCM), PCM System Issues in digital transmission: Frequency Division Multiplexing Time Division Multiplexing, T1 Digital System, TDM Hierarchy	9
IV	Differential Pulse Code Modulation, Delta Modulation. Adaptive Delta Modulation, Voice Coders, Sources of Noises, Frequency domain representation of Noise, Super position of Noises, Linear filtering of Noises, Mathematical Representation of Noise.	7
V	Noise in Amplitude Modulation: Analysis, Signal to Noise Ratio, Figure of Merit. Noise in Frequency Modulation: Pre-emphasis, De-Emphasis and SNR Improvement, Phase Locked Loops Analog and Digital.	7

Text Book:

1. Herbert Taub and Donald L. Schilling, "Principles of Communication Systems", Tata McGraw Hill.
2. Rishabh Anand, Communication Systems, Khanna Publishing House, Delhi

Reference Books:

1. B.P.Lathi,"ModernDigitalandAnalogcommunicationSystems",3rd Edition, Oxford University Press.
2. Simon Haykin, "Communication Systems", 4th Edition, Wiley India.
3. H.P.Hsu& D. Mitra "Analog and Digital Communications", 2nd Edition, Tata McGraw-Hill.

REC503	DIGITAL SIGNAL PROCESSING	
Unit	Topics	Lectures
I	Realization of Digital Systems: Introduction, direct form realization of IIR systems, cascade realization of an IIR systems, parallel form realization of an IIR systems, Ladder structures: continued fraction expansion of H (z), example of continued fraction, realization of a ladder structure, example of a ladder realization, FIR Filter Realization: Direct & Cascade, FIR Linear Phase Realization.	8
II	Design of Infinite Impulse Response Digital Filters: Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and ChebyshevFilters, Frequency Transformations.	8
III	Finite Impulse Response Filter Design: Windowing and the Rectangular Window, Other Commonly Used Windows, Examples of Filter Designs Using Windows, The Kaiser Window, Finite Word length effects in digital filters.	8
IV	DFT & FFT: Definitions, Properties of the DFT, Circular Convolution, Linear Convolution using Circular Convolution, Decimation in Time (DIT) Algorithm, Decimation in Frequency (DIF) Algorithm.	8
V	Multirate Digital Signal Processing: Introduction, Decimation, Interpolation, Sampling rate conversion: Single and Multistage, SubbandCoding of Speech signals, Quadrature mirror filters.	8

Text Book:

1. Johnny R. Johnson, .Digital Signal Processing., PHI Learning Pvt Ltd., 2009.

Reference Books:

1. John G Prokias, Dimitris G Manolakis, .Digital Signal Processing. Pearson Education.
2. Oppenheim & Schafer, . Digital Signal Processing. PHI

LABORATORY

REC551 INTEGRATED CIRCUITS LAB

Objective: - To design and implement the circuits to gain knowledge on performance of thecircuit and its application. These circuits should also be simulated on Pspice and implemented using TL082, LM741, NE555, ASLK, MPY634 KP connecting wires, Power Supply, function generator and oscilloscope.

1. Design and test a function generator that can generate square wave and triangular wave output for a given frequency and cascade a multiplier MPY634KP in feedback loop to form VCO
2. Voltage to current and current to voltage convertors.
3. Second order filters using operational amplifier in universal active filter topology for-
    - **a)** Low pass filter of specified cut off frequency.
    - **b)** High pass filter of specified frequency.
    - **c)** Band pass filter with unit gain of specified pass band
    - **d)** Design a notch filter to eliminate 50Hz power line frequency.
4. Wien bridge oscillator using operational amplifier.
5. Astable and mono-stable multivibrators using IC 555.
6. Design the following amplifiers:
    - **a)** A unity gain amplifier.
    - **b)** A non-inverting amplifier with a gain of "A".
    - **c)** An inverting amplifier with a gain of "A".
    - **d)** Log and antilog amplifiers.
    - **e)** Voltage comparator and zero crossing detectors.
7. Design and test a PLL to get locked to a given frequency „f". Measure the locking range of the system and also measure the change in phase of the output signal as input frequency is varied within the lock range.
8. Design and test the integrator for a given time constant.
9. Design and test a high-Q Band pass self-tuned filter for a given center frequency.
10. Design and test an AGC system for a given peak amplitude of sine-wave output.
11. Design and test a Low Dropout regulator using op-amps for a given voltage regulation characteristic and compare the characteristics with TPS7250IC.
12. Design of a switched mode power supply that can provide a regulated output voltage for a given input range using the TPS40200 IC.

Note: All listed experiments are compulsory. In addition to it, the Institutes may include more experiments based on the expertise.

REC552 **COMMUNICATION LAB-I**

List of Experiments

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2. To study amplitude demodulation by linear diode detector.
3. To study frequency modulation and determine its modulation factor.
4. To study PLL 565 as frequency demodulator.
5. To study sampling and reconstruction of Pulse Amplitude modulation system.
6. To study the Sensitivity, Selectivity, and Fidelity characteristics of super heterodyne receiver.
7. To study Pulse Amplitude Modulation.
    a) using switching method
    b) by sample and hold circuit
8. To demodulate the obtained PAM signal by 2nd order LPF.
9. To study Pulse Width Modulation and Pulse Position Modulation.
10. To study Pulse code modulation and demodulation technique.
11. To study Delta modulation and demodulation technique.
12. Design and implement an FM radio receiver in 88-108 MHz

REC553 **DIGITAL SIGNAL PROCESSING LAB**

List of Experiments

1. To study about DSP Processors and architecture of TMS320C6713 DSP processor.
2. Introduction to MATLAB and Code Composer Studio or its equivalent open source software.
   OR
   Introduction to Scilab Open Source Software (Using Spoken Tutorial MOOCs)
3. Write a Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
4. To study matrix multiplication using code composer studio.
5. Evaluate 4 point DFT of and IDFT of $x(n) = 1, 0 \leq n \leq 3; 0$ elsewhere.
6. To implement FFT algorithm.
7. Verify Blackman and Hamming windowing techniques.
8. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
9. Verify Circular Convolution using code composer studio.
10. Verify Linear convolution of two sequence using code composer studio.
11. To implement Tone Generation.
12. To implement floating point arithmetic.

Spoken Tutorial (MOOCs):

Spoken Tutorial MOOCs, ' Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)

REC554CAD OF ELECTRONICS LAB- I

PSPICE Experiments

1. (a)Transient Analysis of BJT inverter using step input.
   (b)DC Analysis (VTC) of BJT inverter with and without parameters.
2. (a)Transient Analysis of NMOS inverter using step input.
   (b)Transient Analysis of NMOS inverter using pulse input.
   (c)DC Analysis (VTC) of NMOS inverter with and without parameters.
3. (a) Analysis of CMOS inverter using step input.
   (b)Transient Analysis of CMOS inverter using step input with parameters.
   (c)Transient Analysis of CMOS inverter using pulse input.
   (d)Transient Analysis of CMOS inverter using pulse input with parameters.
   (e)DC Analysis (VTC) of CMOS inverter with and without parameters.
4. Transient &DC Analysis of NOR Gate inverter.
5. Transient & DC Analysis of NAND Gate.
6. Design and Simulation of a Differential Amplifier (with Resistive Load, Current Source Biasing)
7. Analysis of frequency response of Common Source amplifiers.
8. Analysis of frequency response of Source Follower amplifiers.
9. Analysis of frequency response of Cascode amplifiers.
10. Analysis of frequency response of Differential amplifiers.

DEPARTMENTAL ELECTIVE COURSE 1

REC051	ANTENNA AND WAVE PROPAGATION	
Unit	Topic	Lectures
I	Antennas Basics:Introduction, Basic Antenna Parameters, Patterns, Beam Area (or Beam Solid Angle) ΩA, Radiation Intensity, Beam Efficiency, Directivity D and Gain G, Directivity and Resolution, Antenna Apertures, Effective Height, The radio Communication link, Fields from Oscillating Dipole, Single-to-Noise Ratio(SNR), Antenna Temperature, Antenna Impedance.	5
II	Application to an Isotropic Source, Radiation Intensity, Arrays of Two Isotropic Point Sources, Non-isotropic but Similar Point Sources and the Principle of Pattern Multiplication, Pattern Synthesis by Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of Equal Amplitude and Spacing, Linear Broadside Arrays with Non-uniform Amplitude Distributions. General Considerations.	8
III	Electric Dipoles, Thin Liner Antennas and Arrays of Dipoles and Apertures: The Short Electric Dipole, The Fields of a Short Dipole, Radiation Resistance of Short Electric Dipole, Thin Linear Antenna, Radiation Resistance of λ/2 Antenna, Array of Two Driven λ/2 Elements: Broadside Case and End-Fire Case, Horizontal Antennas Above a Plane Ground, Vertical Antennas Above a Plane Ground, Yagi-Uda Antenna Design, Long-Wire Antennas, folded Dipole Antennas.	8
IV	The Loop Antenna:Design and its Characteristic Properties, Application of Loop Antennas, Far Field Patterns of Circular Loop Antennas with Uniform Current, Slot Antennas, Horn Antennas, Helical Antennas, The Log-Periodic Antenna, Micro strip Antennas. Reflector Antennas: Flat Sheet Reflectors, Corner Reflectors, The Parabola-General Properties, A Comparison Between Parabolic and Corner Reflectors, The Paraboloidal Reflector, Patterns of Large Circular Apertures with Uniform Illumination, Reflector Types (summarized), Feed Methods for Parabolic Reflectors.	9
V	Ground Wave Propagation: Plane Earth Reflection, Space Wave and Surface Wave. Space Wave Propagation: Introduction, Field Strength Relation, Effects of Imperfect Earth, Effects of Curvature of Earth. Sky wave Propagation**:** Introduction structural Details of the ionosphere, Wave Propagation Mechanism, Refraction and Reflection of Sky Waves by ionosphere, Ray Path, Critical Frequency, MUF, LUF, OF, Virtual Height and Skip Distance, Relation Between MUF and the Skip Distance, Multi-Hop Propagation, Wave Characteristics	10

Text Book:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, “Antennas and Wave Propagation”, Fourth Edition, Tata McGraw Hill.

Reference Books:

1. A. R. Harish, M. Sachidananda, “Antennas and Wave Propogation”, Oxford University Press.
2. Edward Conrad Jordan and Keith George Balmain, “Electromagnetic Waves and Radiating Systems”, PHI.
3. R.L. Yadava, Electromagnetic Waves, Khanna Publishing House, Delhi.
4. A. Das, Sisir K. Das, “Microwave Engineering”, Tata McGraw Hill.

REC052	Computer Architecture and Organization	
Unit	**Topic**	**Lectures**
I	Introduction to Design Methodology: System Design - System representation, Design Process, the gate level (revision), the register level components and PLD (revision), register level design The Processor Level: Processor level components, Processor level design.	8
II	Processor basics: CPU organization- Fundamentals, Additional features Data Representation - Basic formats, Fixed point numbers, Floating point numbers. Instruction sets - Formats, Types, Programming considerations.	8
III	Data path Design: Fixed point arithmetic - Addition and subtraction, Multiplication and Division, Floating point arithmetic, pipelining.	8
IV	Control Design: basic concepts - introduction, hardwired control, Micro programmed control -introduction, multiplier control unit, CPU control unit, Pipeline control- instruction pipelines, pipeline performance.	8
V	Memory organization: Multi level memories, Address translation, Memory allocation, Caches - Main features, Address mapping, structure vs performance, System Organization: Communication methods- basic concepts, bus control. Introduction to VHDL.	8

TextBooks:

1. John P Hayes "Computer Architecture and Organisation", McGraw Hill Publication.

Reference Books:

1. M Morris Mano, "Computer System Architecture", Pearson Publication.
2. Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization and Embedded Systems", McGraw Hill Publication.
3. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier Publication.
4. I. Singh, Computer Organisation and Architecture, Khanna Publishing House, Delhi

REC053	REAL TIME SYSTEMS	
Units	**Topic**	**Lectures**
I	**Introduction to Real Time** System Introduction to Real time Embedded System, need for a real-time system, different kinds (reactive, time driven, deadline driven, etc.,) Embedded system Design cycle, Types of Real Time systems, Real Time Applications and features, Issues in real time computing, aspects of real-time systems (timeliness, responsiveness, concurrency, predictability, correctness, robustness, fault tolerance and safety, resource limitations, RTOS necessity), real-time requirement specifications, modelling/verifying design tools (UML, state charts, etc.,).	8
II	**Embedded Hardware for Real Time** System Selection criteria for Real time system - Hardware and Software perspective, need for partitioning, criteria for partitioning (performance, criticality, development ease, robustness, fault tolerance and safety, resource limitations, etc.,), System Considerations, Basic development environment-host vs target concept, CPU features, Architecture, I/O Ports, on-chip peripherals, Memory, Real time implementation considerations, bus architecture, Introduction to Interrupts, Interrupt vector table, interrupt programming, Pipeline and Parallelism concepts.	10
III	**Embedded Hardware** – On chip Peripherals and Communication protocols Role of peripherals for Real time systems, On-Chip peripherals& hardware accelerators, Peripherals [Direct Memory Access, Timers, Analog to Digital Conversion (ADC), DAC, Comparator, Pulse Width Modulation (PWM)], Need of real time Communication, Communication Requirements, Timeliness, Dependability, Design Issues, Overview of Real time communication, Real time Communication Peripherals – I2C, SPI &UART. Introduction to the CCS IDE: its features, project options and basic examples Analog-to-Digital Converter Lab: Build a data acquisition system Control Peripherals Lab: Generate and graph a PWM waveform Direct Memory Access (DMA) Lab: Use DMA to buffer ADC results.	12
IV	**Embedded Software and RTOS** Software Architecture of real time System, Introduction to RTOS, role of RTOS, foreground Back ground system, pros and cons, Real time kernel, qualities of good RTOS, Functionalities of RTOS – Task Management, I/O management, Memory management, Inter Task Communication, Tasks, Task states, Task control block, attributes of TCB, Context switching, Interrupts handling, Multiprocessing and multitasking.	8
V	**Introduction to TI C2000:** Interface with actuators such as motor control enabling real time capabilities of C2000 Program to demonstrate the Task switching Simulation on CCS IDE To demonstrate the blink led application Using Hwi (Hardware Interrupt: periodically to produce an interrupt using Timers) of TI RTOS. Programming: demonstrate the Blink led application Using a Swi (Software interrupt) of TI RTOS To introduce two time-based SYS/BIOS services – Clock and Timestamp in TI RTOS; demonstrate the Task synchronization using Semaphores using TI RTOS; demonstrate Inter Task Communication Using of Mailboxes and Queues using TI RTOS; demonstrate the Communication Protocols – I2C, SPI and USART using TI.	10

Text Book:

1. Real-Time Systems by Jane W. S. Liu Prentice Hall Publication
2. Krishna .C.M "Real Time Systems" Mc-Graw Hill Publication.
3. Hamid A. Toliyat and Steven G. Campbell, "DSP based Electromechanical Motion Control" CRC Press Publication.
4. Jean J Labrosse, "Embedded System Design blocks", CMP books Publication
5. John H Davies, "MSP430 Microcontroller Basics" Newnes Publication.

Reference Book:

1. TMS320C28x CPU and Instruction Set Reference Guide, TI Literature Publication
2. TMS320x28xx, 28xxx DSP Peripheral Reference Guide, TI Literature Publication
3. C2000 Teaching CD ROM from Texas Instruments Publication
4. Introduction to the TI-RTOS Kernel Workshop Lab Manual, by Texas Instruments Publication

REC054	Artificial Neural Network	
Unit	**Topic**	**Lectures**
I	**Introduction to ANN:** Features, structure and working of Biological Neural Network Trends in Computing Comparison of BNN and ANN. **Basics of Artificial Neural Networks** - History of neural network research, characteristics of neural networks terminology, models of neuron McCulloch - Pitts model, Perceptron, Ada line model, Basic learning laws, Topology of neural network architecture	8
II	**Back propagation networks** : (BPN) Architecture of feed forward network, single layer ANN, multilayer perceptron, back propagation learning, input - hidden and output layer computation, back propagation algorithm, applications, selection of tuning parameters in BPN, Numbers of hidden nodes, learning.	8
III	**Activation & Synaptic Dynamics** : Introduction, Activation Dynamics models, synaptic Dynamics models, stability and convergence, recall in neural networks. **Basic functional units of ANN for pattern recognition tasks:** Basic feed forward, Basic feedback and basic competitive learning neural network. Pattern association, pattern classification and pattern mapping tasks.	8
IV	**a)Feedforward neural networks** -- Linear responsibility X-OR problem and solution. - Analysis of pattern mapping networks summary of basic gradient search methods. **b) Feedback neural networks Pattern** Storage networks, stochastic networks and simulated annealing, Boltzmann machine and Boltzmann learning.	8
V	**Competitive learning neural networks** : Components of CL network pattern clustering and feature. Mapping network, ART networks, Features of ART models, character recognition using ART network. **Applications of ANN**: Pattern classification - Recognition of Olympic games symbols, Recognition of printed Characters. Neocognitron - Recognition of handwritten characters. NET Talk: to convert English text to speech. Recognition of consonant vowel (CV) segments, texture classification and segmentation.	8

Text Book:

1. B. Yegnanarayana, "Artificial neural Networks", PHI Publication.

Reference Books:

1. S. Raj Sekaran ,VijayalakshmiPari," Neural networks, Fuzzy logic and Genetic Algorithms", PHI Publication.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence", TMH Publication.

REC055	ADVANCE SEMICONDUCTOR DEVICES	
Unit	Topics	Lectures
I	Physics of Semiconductors, P-N Junction Diode and BJT: Introduction, Crystal Structure, Phonon, Optical, and Thermal Properties,*p-n* Junctions –Junction Breakdown, Transient Behavior and Noise Terminal Functions.BJT:Static Characteristics, Microwave Characteristics, Related Device Structures, Heterojunction Bipolar Transistor.	8
II	MOSFET, Hetero-Junctions and Basics of Nanostructures: MOSFET: Basic Device Characteristics, Nonuniform Doping and Buried Channel Device, Device Scaling and Short-Channel Effects, MOSFET Structures, Circuit Applications, Single Electron Transistor, JFETs. Hetero-junctions:Metal-Semiconductor Contacts, Metal-Insulator-Semiconductor Capacitors. MESFETs and MODFETs. Nanostructures: Basic Equations and Examples.	8
III	TUNNEL Devices and IMPATT Diodes: TUNNEL DEVICES:Tunnel Diode, Related Tunnel Devices, Resonant Tunneling Diode. IMPATT Diodes: Static Characteristics, Dynamic Characteristics, Power and Efficiency Noise Behavior, Device Design and Performance, BARITT Diode, TUNNETT Diode	8
IV	Power devices, Photonic devices:Transferred-Electron and Real-Space-Transfer Devices Thyristors, Power Devices. Photonic Devices and Sensors: Radiative Transitions, Light-Emitting Diode (LED), Laser Physics, Laser Operating Characteristics, Specialty Lasers	8
V	Photodetectors, Solar Cells and Sensors:Photodiodes, Avalanche Photodiode and Phototransistor, Charge-Coupled Device (CCD), Metal- Semiconductor-Metal Photodetector, Quantum-Well Infrared Photodetector, Solar Cell Sensors: Thermal Sensor, Mechanical Sensors, Magnetic Sensors and Chemical Sensors	8

Text Book:

1. S. M. Sze, Kwok K. NG, “Physics of Semiconductor Devices”, 3rd Edition, Wiley Publication

Reference Books:

1. J. P. Colinge and C. A. Colinge, "Physics Of Semiconductor Devices", Kluwer Academic Publishers
2. B. G. Streetman and S. Banerjee “Solid state electronics devices”, 5th Edition, PHI.
3. SupriyoDatta, “Quantum Transport Atom to Transistor”, Cambridge University Press, 2005
4. A.K. Maini, All in One Electronics Simplified, Khanna Publishing House, Delhi

RIC603 CONTROL SYSTEM-I		
Unit	**Topic**	**Lectures**
I	Basic Components of a control system, Feedback and its effect, types of feedback control systems. Block diagrams Reduction and signal flow graphs, Modeling of Physical systems: electrical networks, mechanical systems elements, equations of mechanical systems, sensors and encoders in control systems, DC motors in control systems, Analogous Systems.	8
II	State-Variable Analysis: Vector matrix representation of state equation, state transition matrix, state-transition equation, relationship between state equations and high-order differential equations, relationship between state equations and transfer functions. Similarity Transformation, Decomposition of transfer functions, Controllability and observability, Eigen Value and Eigen Vector, Diagonalization.	8
III	Time domain Analysis of Control Systems: Time response of continuous data systems, typical test signals for the time response of control systems, the unit step response and time-domain specifications, Steady-State error, time response of a first order system, transient response of a prototype second order system.	8
IV	Stability of Linear Control Systems: Bounded-input bounded-output stability continuous data systems, zero-input and asymptotic stability of continuous data systems, Routh Hurwitz criterion. Root-Locus Technique: Introduction, Properties of the Root Loci, Design aspects of the Root Loci.	8
V	Frequency Domain Analysis: Mr (resonant peak) and ωr (resonant frequency) and bandwidth of the prototype Second order system, effects of adding a zero to the forward path, effects of adding a pole to the forward path, Polar Plot, Nyquist stability criterion, relative stability: gain margin and phase margin, stability analysis with the Bode plot.	8

Text Book:

1. B.C. Kuo&FaridGolnaraghi, "Automatic Control Systems", 8th Edition, John Wiley India, 2008.

Reference Books:

1. I. J. Nagrath& M. Gopal, "Control System Engineering", New Age International Publishers
2. A. Ambikapathy, Control Systems, Khanna Publishing House, Delhi.
2. Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems" Schaums Outlines Series, 3rdEdition, Tata McGraw Hill, Special Indian Edition 2010.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2010.

REC601	MICROWAVE ENGINEERING	
Unit	**Topics**	**Lectures**
I	**Rectangular & circular waveguides:Introduction to microwave communication and EM spectrum**, Rectangular wave guide: Field Components, TE, TM Modes, Dominant TE10 mode, Field Distribution, Power, Attenuation. Circular waveguides: TE, TM modes. Wave velocities, Microstrip transmission line (TL), Coupled TL, Strip TL, Coupled strip line, Coplanar TL, Microwave cavities	11
II	**Passive microwave devices:** 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.	10
III	**Microwave tubes :**Microwave tubes: Limitations of conventional active devices at microwave frequency, Two cavity Klystron, Reflex Klystron, Magnetron, Traveling wave tube, Backward wave oscillators, Gyro Devices: Their schematic, Principle of operation, Performance characteristic and their applications.	7
IV	**Solid state amplifiers and oscillators:** Transferred electron devices: Gunn-effect diodes & modes of operation. Avalanche transit – time devices: IMPATT diode, TRAPPAT diode, BARITT diode.	5
V	**Microwave Measurements:** VSWR meter, Frequency meter, Spectrum analyser, Network analyser,Tunable detector, Slotted line carriage, Power meter, Microwave power measurement, Insertion loss and attenuation measurement, VSWR measurement, Return loss measurement by a reflectometer, Frequency measurement, measurement of cavity Q, Dielectric constant measurement of a solid, EM radiation & measurement.	7

Text Books:

1. G. S. Raghuvanshi, Microwave Engineering; Cengage
2. S.Y. Liao, Microwave Devices & Circuits; PHI 3rd Ed.

Reference Books:

1. A Das and S.K. Das, Microwave Engineering; McGraw Hill Education
2. S. Vasuki, D Margaret Helena, R Rajeswari, Microwave Engineering; MHE
3. M.I. Skolnik, Introduction to Radar Engineering ; TMH
4. Om P. Gandhi, Microwave Engineering and Applications; Pergamon Press

REC602	DIGITAL COMMUNICATION	
Unit	**Topic**	**Lectures**
I	Principles of digital data transmission: Digital Data transmission, Line coding review, Pulse shaping, Scrambling, Digital receivers, Eye diagram, Digital carrier system. Method of generation and detection of coherent & non-coherent binary ASK, FSK & PSK, Differential phase shift keying, Quadrature modulation techniques. (QPSK and MSK), M-ary Digital carrier Modulation.	08
II	Fundamentals of probability theory & random process : Concept of Probability, Random variable, Statistical averages, Correlation, Sum of Random Variables, Central Limit Theorem, Random Process, Classification of Random Processes Power spectral density, Multiple random Processes.	08
III	Performance Analysis of Digital communication system: Optimum linear Detector for Binary polar signaling, General Binary Signaling, Coherent Receivers for Digital Carrier Modulations, Signal Space Analysis of Optimum Detection, Vector Decomposition of White Noise Random processes, General Expression for Error Probability of optimum receivers	08
IV	Spread spectrum Communications: Frequency Hopping Spread Spectrum(FHSS) systems, Direct Sequence Spread Spectrum, Code Division Multiple Access of DSSS, Multiuser Detection, OFDM Communications Introduction to information theory: Measure of Information, Source Encoding, Error Free Communication over a Noisy Channel. Capacity of a discrete and Continuous Memory less channel.	08
V	Error Correcting codes: Hamming sphere, hamming distance and Hamming bound, relation between minimum distance and error detecting and correcting capability Linear block codes: encoding and syndrome decoding. Cyclic codes: encoder and decoder for systematic cyclic codes. Convolution codes, code tree and Trellis diagram, Viterbi and sequential decoding, Burst error correction, Turbo codes.	08

Text Book:

1. B.P. Lathi, “Modern Digital and Analog communication Systems”, 4th Edition, Oxford University Press, 2010.
2. RishabhAnand, Communication Systems, Khanna Publishing House, Delhi.

Reference Books:

1. H. Taub, D L Schilling, GautamSaha, “Principles of Communication”, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd.
2. John G. Proakis, “Digital Communications”, 4th Edition, McGraw-Hill International.
3. Simon Haykin, “Communication Systems”, 4th Edition, Wiley India.
4. H P HSU & D Mitra, “Analog and Digital Communications”, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd.

LABORATORY

REC651 **MICROWAVE ENGINEERING LAB**

List of Experiments

1. To study microwave test bench.
2. To study the characteristics of reflex klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working on TE_{01} mode.
4. To study measurement of reflection coefficient and standing wave ratio using double minima method.
5. To study V-I characteristic of Gunn diode.
6. To measure an unknown impedance with Smith chart.
7. Study of Circulator/Isolator.
8. Study of Attenuator (Fixed and Variable type).
9. To study simple dipole $\lambda/2$ antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
10. To study folded dipole antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
11. To study $\lambda/2$ phase array end-fire antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
12. To study broadside array antenna and to calculate beam-width, front / back ratio, and gain of the antenna.

REC652 **COMMUNICATION LAB – II**

List of Experiments

1. To construct a Square wave with the help of Fundamental Frequency and its Harmonic component
2. Study of pulse data coding & decoding techniques for NRZ and RZ formats.
3. Study of Manchester coding and Decoding.
4. Study of Amplitude shift keying modulator and demodulator.
5. Study of Frequency shift keying modulator and demodulator.
6. Study of Phase shift keying modulator and demodulator.
7. Study of single bit error detection and correction using Hamming code.
8. Study of Quadrature Phase shift keying modulator and demodulator.
9. To simulate Differential Phase shift keying technique using MATLAB software.
10. To simulate M-ary Phase shift keying technique using MATLAB software (example8PSK, 16PSK) and perform BER calculations.
11. To simulate convolutional coding using MATLAB software.
12. Design a front end BPSK modulator and demodulator.

RIC653CONTROL SYSTEM LAB-I

List of Experiments:

1. Different Toolboxes in MATLAB, Introduction to Control Systems Toolboxor its equivalent open source freeware software like Scilabusing Spoken Tutorial MOOCs.
2. Determine transpose, inverse values of given matrix.
3. Plot the pole-zero configuration in s-plane for the given transfer function.
4. Determine the transfer function for given closed loop system in block diagram representation.
5. Plot unit step response of given transfer function and find delay time, rise time, peak time and peak overshoot.
6. Determine the time response of the given system subjected to any arbitrary input.
7. Plot root locus of given transfer function, locate closed loop poles for different values of k. Also find out Wd and Wnat for a given root.
8. Create the state space model of a linear continuous system.
9. Determine the State Space representation of the given transfer function.
10. Plot bode plot of given transfer function. Also determine the relative stability by measuring gain and phase margins.
11. Determine the steady state errors of a given transfer function.
12. Plot Nyquist plot for given transfer function and to discuss closed loop stability. Also determine the relative stability by measuring gain and phase margin.

Spoken Tutorial (MOOCs):

Spoken Tutorial MOOCs, ' Course on Scilab', IIT Bombay (http://spoken-tutorial.org/)

RIC651 MICROCONTROLLERS FOR EMBEDDED SYSTEMS LAB

1. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
2. Write a program to generate 10 kHz square wave using 8051.
3. Write a program to show the use of INT0 and INT1 of 8051.
4. Write a program for temperature & to display on intelligent LCD display.
5. Write a program to generate a Ramp waveform using DAC with micro controller.
6. Write a program to Interface GPIO ports in C using MSP430 (blinking LEDs , push buttons)
7. Write a program Interface potentiometer with GPIO.
8. Write a program of PWM based Speed Control of Motor controlled by potentiometer connected to GPIO.
9. Write a program of PWM generation using Timer on MSP430 GPIO.
10. Write a program to Interface an accelerometer.
11. Write a program using USB (Sending data back and forth across a bulk transfer-mode USB connection.)
12. Write a program for Master Slave Communication between 2 MSP430s using SPI
13. Write a program of basic Wi-Fi application – Communication between two MSP430 based sensor nodes.
14. Setting up the CC3100 as a HTTP server.
15. Review of User APIs for TI CC3100 & Initialization and Setting of IP addresses.

DEPARTMENTAL ELECTIVE COURSE 2

REC061	INDUSTRIAL ELECTRONICS	
Unit	Topics	Lectures
I	**Power Semiconductor Devices**: Power semiconductor devices their symbols and static characteristics and specifications of switches, types of power electronic circuits Operation, steady state & switch characteristics & switching limits of Power Transistor Operation and steady state characteristics of Power MOSFET and IGBT Thyristor – Operation V- I characteristics, two transistor model, methods of turn-on Operation of GTO, MCT and TRIAC.	8
II	**Phase Controlled Rectifiers:** Phase Angle Control, Single-phase Half-wave Controlled Rectifier (One quadrant), Single-phase Full-wave Controlled Rectifier (Two quadrant Converters),Performance Factors of Line-commutated Converters, The Performance Measures of Two-pulse Converters, Three phase Controlled Converters **Inverters**: Introduction Thyristor Inverter Classification, Series Inverters, Parallel Inverter, Three-phase Bridge Inverters, Three-phase Bridge Inverter with Input-circuit Commutation.	8
III	**Choppers:** Introduction, Principle of Chopper Operation, Control Strategies, stepup/Down Chopper, Jones Chopper. Introduction to basic Cycloconverters. Control of D.C. Drives: Introduction, Basic Machine Equations, Breaking Modes, Schemes for D.C. Motor Speed Control, Single-phase Separately Excited Drives, Braking Operation of Rectifier Controlled Separately excited Motor, Single-phase Separately Excited Drives, Power Factor Improvement, Three-phase Separately Excited Drives, D.C. Chopper Drives	8
IV	**Control of A.C. Drives:** Introduction, basic Principle of Operation, Squirrel-cage Rotor Design, Speed Control of Induction Motors, stator Voltage Control, Variable Frequency control, Rotor Resistance Control, Slip Power Recovery Scheme, Synchronous Motor Drives	8
V	Protection of device and circuits: Introduction, Cooling and heat sinks, Thermal Modeling of Power Switching devices, Snubber Circuits, Reverse Recovery Transients, Supply- and Load- side Transients, Voltage Protection, Current Protections, Electromagnetic Interference.	8

Text Books:

1. M. H. Rashid, “Power Electronics”, 3rd Edition, Pearson Education.
2. M. D. Singh & K. Khanchandani, “Power Electronics”, Tata McGraw Hill.

Reference Books:

1. V.R. Moorthy, “Power Electronics: Devices, Circuits and Industrial Applications”, Oxford University Press,2007.
2. M.S. JamilAsghar, “Power Electronics”,PHI.
3. Chakrabarti&Rai, “Fundamentals of Power Electronics &Drives”DhanpatRai& Sons.
4. Ned Mohan, T.M.Undeland and W.P.Robbins, “Power Electronics:Converters, Applications and Design”, Wiley India.
5. S.N.Singh, “A Text Book of Power Electronics”,DhanpatRai& Sons.

REC602 MICROCONTROLLER FOR EMBEDDED SYSTEMS		
Unit	**Topic**	**Lectures**
I	Introduction , Microcontrollers and Embedded systems, Overview of the 8051, Inside the 8051, Addressing modes, assembly programming, 8051 data types and directives, Interfacing with 8051, Programming the 8051 timers	6
II	MSP430x5x series block diagram, address space, on-chip peripherals (analog and digital), and Register sets. Instruction set, instruction formats, and various addressing modes of 16-bit microcontroller; Sample embedded system on MSP430 microcontroller. Memory Mapped Peripherals, programming System registers, I/O pin multiplexing, pull up/down registers, GPIO control. Interrupts and interrupt programming.	
III	Watch dog timer, system clocks, Timer & Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition ADC and Comparator in MSP430, data transfer using DMA.	10
IV	Serial communication basics, Synchronous/Asynchronous interfaces (like UART, USB, SPI, and I2C). UART protocol, I2C protocol, SPI protocol. Implementing and programming UART, I2C, SPI interface using MSP430, Interfacing external devices.	10
V	Internet of Things (IoT) overview and architecture, Overview of wireless sensor networks and design examples. Various wireless connectivity: NFC, ZigBee, Bluetooth, Bluetooth Low Energy, Wi-Fi. Adding Wi-Fi capability to the Microcontroller, Embedded Wi-Fi, User APIs for Wireless and Networking applications, Building IoT applications using CC3100 user API for connecting sensors.	6

Text Book:

1. Mazidi Ali Muhammad, MazidiGillispie Janice, and McKinlayRolin D " The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication.
2. John H Davies, "MSP430 Microcontroller Basics" Newnes Publication.

Reference Book:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide.

REC063	ANALOG SIGNAL PROCESSING	
Unit	Topics	Lectures
I	Introduction to domains and the analogue/digital trade off, Introduction to current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations. Second-order filter realization, filter design parameters (Q and ω_0), frequency response, Three op-amp biquad, effect of finite gain of op-amp over filters, Sallen-Key biquad.	10
II	Ideal low-pass filter, Buttreworth and Chebyshev magnitude response, pole locations, low-pass filter specifications, comparison of Maximally flat and Equal ripple responses.	8
III	Delay equalization: equalization procedures, equalization with first-order and second order modules, strategies for equalization design. Definition of Bode sensitivity.	7
IV	The General Impedance Convertor (GIC), optimal design of the GIC, realization of simple ladders, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique, creating negative components.	8
V	Elementary transconductor building blocks, resistors, integrators, amplifiers, summers, Gyrator, First and second order filters, Higher order filters	**7**

Text Book:

1. R. Schaumann and M.E. Valkenberg,"Design of Analog Circuits", Oxford University Press

REC064	ADVANCED DIGITAL DESIGN USING VERILOG	
Unit	**Topic**	**Lectures**
I	ntroduction to Mixed Logic, Logic Representation and Minimization with cost, Multiple output minimization, Entered Variable K- Map including don't care handling, XOR Pattern Handling.	8
II	Combinational Circuit Design, Multiplexers, Decoders, Encoders, Code Comparators, Adders, Subtractors, Multipliers, Introduction to Verilog, Behavioral and Structural specification of logic circuits, Boolean function implementation using Verilog, Timing Analysis, Hazard Detection and Elimination	8
III	Synchronous Sequential Circuits Design, Mapping Algorithm, Synchronous StateMachines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi-levelminimization and optimization.	8
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis incombinational and sequential systems, Path Sensitization method, Boolean DifferenceMethod, Initial State Method.	8
V	Study of programmable logic families, PLD, CPLD, FPGA, ASIC, PLA, Architectures,Design of Combinational and sequential circuits using CPLD and FPGA, Design Examples.	8

Text Books:

1. Richard F. Tinder, "Engineering Digital Design", Academic Press.
2. Parag K. Lala, "Digital system Design Using PLDs", PHI India Ltd.
3. Stephen Brown and ZvonkoVranesiv, "Fundamental of Digital Logic with Verilog Design", Tata McGraw Hill.

Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication.
2. Eugene Fabricius, "Modern Digital Design and Switching Theory", CRC Press.
3. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
4. Alexander Miczo, "Digital Logic Testing and Simulation",WileyInterscience.

REC065RADAR ENGINEERING

Unit	Topics	Lectures
I	**Introduction to Radar:** Basic radar, The simple form of radar equation, Radar block diagram, Radar frequencies, Applications to radar.	5
II	**Radar Equation:** Introduction, Detection of signal in noise, Receiver noise and the signal to noise ratio, Probability density functions, Probabilities of detection and false alarm, Integration of Radar pluses, Radar cross section of targets, Radar cross section fluctuations, Transmitter power, Pulse repetition frequency, antenna parameters, system losses, Other Radar equation considerations.	9
III	**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, Limitation of MTI performance, MTI from a moving platform, Pulse Doppler Radar, CW Radar.	9
IV	**Tracking Radar:** Tracking with Radar, Mono-pulse tracking, Conical scan and sequential lobbing, Limitation to tracking accuracy, Low-angle tracking, Tracking in range, Comparison of trackers, Automatic tracking with Surveillance Radar (ADT)	8
V	**Information from Radar signals:** Basic Radar measurements, Ambiguity diagram, Pulse compression, Target recognition. **Radar Clutter:** Land clutter, Sea clutter, Weather clutter and detection of targets in clutter.	9

Text Book:

1. Merrill I. Skolnik“ Introduction to Radar Systems” Third Edition.

Reference Book:

1 J.C. Toomay , Paul J. Hannen “ Principles of Radar” Third Edition.
2 GottapuSasibhusanaRao, “Microwave and Radar Engineering, Pearson.
3 Bernard Davis,George Kennedy, Electronic Communication Systems, Tata McGraw-Hill Education Pvt. Ltd.

KVE401	Universal Human Values and Professional Ethics	L	T	P	C
		3	0	0	3

Objectives:

1. To help students distinguish between values and skills, and understand the need, basic guidelines, content and process of value education.
2. To help students initiate a process of dialog within themselves to know what they 'really want to be' in their life and profession
3. To help students understand the meaning of happiness and prosperity for a human being.
4. To facilitate the students to understand harmony at all the levels of human living, and live accordingly.
5. To facilitate the students in applying the understanding of harmony in existence in their profession and lead an ethical life

Course Outcome:

On completion of this course, the students will be able to

1. Understand the significance of value inputs in a classroom, distinguish between values and skills, understand the need, basic guidelines, content and process of value education, explore the meaning of happiness and prosperity and do a correct appraisal of the current scenario in the society
2. Distinguish between the Self and the Body, understand the meaning of Harmony in the Self the Co-existence of Self and Body.
3. Understand the value of harmonious relationship based on trust, respect and other naturally acceptable feelings in human-human relationships and explore their role in ensuring a harmonious society
4. Understand the harmony in nature and existence, and work out their mutually fulfilling participation in the nature.
5. Distinguish between ethical and unethical practices, and start working out the strategy to actualize a harmonious environment wherever they work.

Catalogue Description

Every human being has two sets of questions to answer for his life: a) what to do? and, b) how to do?. The first set pertains to the value domain, and the other to the skill domain. Both are complimentary, but value domain has a higher priority. Today, education has become more and more skill biased, and hence, the basic aspiration of a human being, that is to live with happiness and prosperity, gets defeated, in spite of abundant technological progress. This course is aimed at giving inputs that will help to ensure the right understanding and right feelings in the students in their life and profession, enabling them to lead an ethical life. In this course, the students learn the process of self-exploration, the difference between the Self and the Body, the naturally acceptable feelings in relationships in a family, the comprehensive human goal in the society, the mutual fulfillment in the nature and the co-existence in existence. As a natural outcome of such inputs, they are able to evaluate an ethical life and profession ahead.

UNIT-1 **Course Introduction - Need, Basic Guidelines, Content and Process for Value Education**

Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration–what is it? - its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

UNIT-2 **Understanding Harmony in the Human Being - Harmony in Myself**

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha, Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-3 **Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship**

Understanding harmony in the Family- the basic unit of human interaction , Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*; Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship, Understanding the meaning of *Vishwas*; Difference between intention and competence, Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship, Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitva* as comprehensive Human Goals, Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!.

UNIT-4 **Understanding Harmony in the Nature and Existence - Whole existence as Co-existence**

Understanding the harmony in the Nature, Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature, Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-5 **Implications of the above Holistic Understanding of Harmony on Professional Ethics**

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify the scope and characteristics of people-friendly and eco-friendly

production systems, technologies and management models, Case studies of typical holistic technologies, management models and production systems, Strategy for transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society: as mutually enriching institutions and organizations.

Text Books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics.

References:

1. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth – Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. P L Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers.
8. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) KrishiTantraShodh, Amravati.
9. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers , Oxford University Press
10. M Govindrajran, S Natrajan & V.S. Senthil Kumar, Engineering Ethics (including Human Values), Eastern Economy Edition, Prentice Hall of India Ltd.
11. B P Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
12. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

Mode of Evaluation:

Assignment/ Seminar/Continuous Assessment Test/Semester End Exam

Mathematics-IV
(PDE, Probability and Statistics)
Computer/Electronics/Electrical & Allied Branches, CS/IT, EC/IC, EE/EN, Mechanical& Allied Branches, (ME/AE/AU/MT/PE/MI/PL) Textile/Chemical & Allied Branches, TT/TC/CT, CHE/FT

Subject Code	KAS302/KAS402					
Category	Basic Science Course					
Subject Name	MATHEMATICS-IV					
Scheme and Credits	**L-T-P**	**Theory Marks**	**Sessional**		**Total**	**Credit**
			Test	**Assig/Att.**		
	3—1—0	100	30	20	150	4
Pre- requisites (if any)	Knowledge of Mathematics I and II of B. Tech or equivalent					

Course Outcomes

The objective of this course is to familiarize the students with partial differential equation, their application and statistical techniques. It aims to present the students with standard concepts and tools at an intermediate to superior level that will provide them well towards undertaking a variety of problems in the discipline.

The students will learn:

- The idea of partial differentiation and types of partial differential equations
- The idea of classification of second partial differential equations, wave , heat equation and transmission lines
- The basic ideas of statistics including measures of central tendency, correlation, regression and their properties.
- The idea s of probability and random variables and various discrete and continuous probability distributions and their properties.
- The statistical methods of studying data samples, hypothesis testing and statistical quality control, control charts and their properties.

Module I: Partial Differential Equations

Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.

Module II: Applications of Partial Differential Equations:

Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines.

Module III: Statistical Techniques I:

Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non linear regression.

Module IV: Statistical Techniques II:

Probability and Distribution: Introduction, Addition and multiplication law of probability, Conditional probability, Baye's theorem, Random variables (Discrete and Continuous Random variable) Probability mass function and Probability density function, Expectation and variance, Discrete and Continuous Probability distribution: Binomial, Poission and Normal distributions.

Module V: **Statistical Techniques III:**

Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables ($\bar{X}$ and R Charts), Control Charts for Variables (p, np and C charts).

Text Books

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2.T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi.
3. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.
4. J.N. Kapur: Mathematical Statistics; S. Chand & Sons Company Limited, New Delhi.
5. D.N.Elhance,V. Elhance & B.M. Aggarwal: Fundamentals of Statistics; Kitab Mahal Distributers, New Delhi.

COURSE OUTCOMES

	Course Outcome (CO)	Bloom's Knowledge Level (KL)
	At the end of this course, the students will be able to:	
CO 1	Remember the concept of partial differential equation and to solve partial differential equations	K_1& K_3
CO 2	Analyze the concept of partial differential equations to evaluate the problems concerned with partial differential equations	K_4 & K_5
CO 3	Understand the concept of correlation, moments, skewness and kurtosis and curve fitting	K_2
CO 4	Remember the concept of probability to evaluate probability distributions	K_1 & K_5
CO 5	Apply the concept of hypothesis testing and statistical quality control to create control charts	K_3 & K_6

K_1 – Remember, K_2 – Understand, K_3 – Apply, K_4 – Analyze, K_5 – Evaluate, K_6 – Create

Evaluation methodology to be followed:

The evaluation and assessment plan consists of the following components:

a. Class attendance and participation in class discussions etc.
b. Quiz.
c. Tutorials and assignments.
d. Sessional examination.
e. Final examination.

Award of Internal/External Marks:

Assessment procedure will be as follows:

1. These will be comprehensive examinations held on-campus (Sessionals).
2. Quiz.
   a. Quiz will be of type multiple choice, fill-in-the-blanks or match the columns.
   b. Quiz will be held periodically.
3. Tutorials and assignments
   a. The assignments/home-work may be of multiple choice type or comprehensive type at least one assignment from each Module/Unit.
   b. The grades and detailed solutions of assignments (of both types) will be accessible online after the submission deadline.
4. Final examinations. These will be comprehensive external examinations held on-campus or off campus (External examination) on dates fixed by the Dr. APJ Abdul Kalam Technical University, Lucknow.

Semester-IV

KEC401	Communication Engineering	3L:0T:0P	3 Credits

Unit	Topics	Lectures
I	Review of signals and systems, frequency domain representation of signals, principles of amplitude modulation systems- DSB, SSB and VSB modulations.	8
II	Angle modulation, representation of FM and PM signals, spectral characteristics of angle modulated signals.	8
III	Review of probability and random process, Gaussian and white noise characteristics, noise in amplitude modulation systems, noise in frequency modulation systems, pre-emphasis and de-emphasis, threshold effect in angle modulation.	8
IV	Pulse modulation, sampling process, pulse amplitude and pulse code modulation (PCM), differential pulse code modulation. Delta modulation, noise considerations in PCM, time division multiplexing, digital multiplexers.	8
V	Digital modulation schemes- phase shift keying, frequency shift keying, quadrature amplitude modulation, continuous phase modulation and minimum shift keying.	8

Text/Reference Books:

1. Haykin S., "Communications Systems," John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering," Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems," Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., "Principles of Communication Engineering," John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., "Digital Communication," Kluwer Academic Publishers, 2004.
6. Proakis J.G., "Digital Communications',' 4th Edition, McGraw Hill, 2000.
7. Abhay Gandhi, "Analog and Digital Communication," Cengage publication, 2015.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth.
2. Analyze the behavior of a communication system in presence of noise.
3. Investigate pulsed modulation system and analyze their system performance.
4. Investigate various multiplexing techniques.
5. Analyze different digital modulation schemes and compute the bit error performance.

KEC402	Analog Circuits	3L:1T:0P	4 Credits

Unit	Topics	Lectures
I	Diode circuits, amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans-resistance amplifier. biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.	8
II	High frequency transistor models, frequency response of single stage and multistage amplifiers, cascode amplifier, various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues, feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.	8
III	Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators.	8
IV	Current mirror: Basic topology and its variants, V-I characteristics, output resistance and minimum sustainable voltage (VON), maximum usable load, differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR, Op-Amp design: Design of differential amplifier for a given specification, design of gain stages and output stages, compensation.	8
V	Op-Amp applications: Review of inverting and non-inverting amplifiers, integrator and differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications, active filters: Low pass, high pass, band pass and band stop, design guidelines.	8

Text/Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, "Introduction to Operational Amplifier theory and applications," Mc Graw Hill, 1992.
2. J. Millman and A. Grabel, "Microelectronics," 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, "The Art of Electronics," 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, "Microelectronic Circuits," Saunder's College11 Publishing, 4th edition.
5. Paul R. Gray and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits," John Wiley, 3rd edition.
6. Muhammad H. Rashid, "Electronic Devices and Circuits," Cengage publication, 2014.

Course Outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the characteristics of diodes and transistors.
2. Design and analyze various rectifier and amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Design LPF, HPF, BPF, BSF.

KEC403	Signal System	3L:1T:0P	4 Credits

Unit	Topics	Lectures
I	Signals and systems as seen in everyday life, and in various branches of engineering and science, energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals, system properties: linearity, additivity and homogeneity, shift-invariance, causality, stability, realizability.	8
II	Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behaviour with aperiodic convergent inputs, characterization of causality and stability of linear shift invariant systems, system representation through differential equations and difference equations, Periodic and semi-periodic inputs to an LSI system, the notion of a frequency response and its relation to the impulse response	8
III	Fourier series representation, Fourier transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality , Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier transform (DFT), Parseval's Theorem, the idea of signal space and orthogonal bases, the Laplace transform, notion of Eigen functions of LSI systems, a basis of Eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behaviour.	8
IV	The z-Transform for discrete time signals and systems-Eigen functions, region of convergence, z-domain analysis.	8
V	The sampling theorem and its implications- spectra of sampled signals, reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on, aliasing and its effects, relation between continuous and discrete time systems.	8

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems," Pearson, 2015.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete," 4th edition, Prentice Hall, 1998.
3. B.P. Lathi, "Signal Processing and Linear Systems," Oxford University Press, 1998.
4. Douglas K. Lindner, "Introduction to Signals and Systems," McGraw Hill International Edition: 1999.
5. Simon Haykin, Barry van Veen, "Signals and Systems," John Wiley and Sons (Asia) Private Limited, 1998.
6. V. Krishnaveni, A. Rajeswari, ""Signals and Systems," Wiley India Private Limited, 2012.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems," John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB," TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems," TMH New Delhi, 2001.
10. A. Anand Kumar, "Signals and Systems," PHI 3rd edition, 2018.
11. D. Ganesh Rao, K.N. Hari Bhat, K. Anitha Sheela, "Signal, Systems, and Stochastic Processes," Cengage publication, 2018.

Course outcomes:

At the end of this course students will demonstrate the ability to:

1. Analyze different types of signals.
2. Analyze linear shift-invariant (LSI) systems.
3. Represent continuous and discrete systems in time and frequency domain using Fourier series and transform.
4. Analyze discrete time signals in z-domain.
5. Study sampling and reconstruction of a signal.

KEC451	Communication Engineering Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS

1. To study DSB/ SSB amplitude modulation & determine its modulation factor & power in side bands.
2. To study amplitude demodulation by linear diode detector.
3. To study frequency modulation and determine its modulation factor.
4. To study sampling and reconstruction of pulse amplitude modulation system.
5. To study pulse amplitude modulation.
   a) Using switching method
   b) By sample and hold circuit
6. To demodulate the obtained PAM signal by 2nd order LPF.
7. To study pulse width modulation and pulse position modulation.
8. To study pulse code modulation and demodulation technique.
9. To study delta modulation and demodulation technique.
10. To construct a square wave with the help of fundamental frequency and its harmonic component.
11. Study of amplitude shift keying modulator and demodulator.
12. Study of frequency shift keying modulator and demodulator.
13. Study of phase shift keying modulator and demodulator.
14. Study of single bit error detection and correction using hamming code.
15. Study of quadrature phase shift keying modulator and demodulator.
16. To simulate differential phase shift keying technique using MATLAB software.
17. To simulate M-ary Phase shift keying technique using MATLAB software (8PSK, 16PSK) and perform BER calculations.
18. Design a front end BPSK modulator and demodulator.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and compare different analog modulation schemes for their modulation factor and power.
2. Study pulse amplitude modulation.
3. Analyze different digital modulation schemes and can compute the bit error performance.
4. Study and simulate the Phase shift keying.
5. Design a front end BPSK modulator and demodulator.

KEC452	Analog Circuit Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS

1. Characteristic of BJT: Study of BJT in various configurations (such as CE/CS, CB/CG, CC/CD).
2. BJT in CE configuration: Graphical measurement of h-parameters from input and output characteristics, measurement of Av, AI, Ro and Ri of CE amplifier with potential divider biasing.
3. Study of Multi-stage amplifiers: Frequency response of single stage and multistage amplifiers.
4. Feedback topologies: Study of voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc.
5. Measurement of Op-Amp parameters: Common mode gain, differential mode gain, CMRR, slew rate.
6. Applications of Op-Amp: Op-Amp as summing amplifier, difference amplifier, integrator and differentiator.
7. Field effect transistors: Single stage common source FET amplifier –plot of gain in dB vs frequency, measurement of bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
8. Oscillators: Study of sinusoidal oscillators- RC oscillators (phase shift, Wien bridge etc.).
9. Study of LC oscillators (Hartley, Colpitt, Clapp etc.),
10. Study of non-sinusoidal oscillators.
11. Simulation of amplifier circuits studied in the lab using any available simulation software and measurement of bandwidth and other parameters with the help of simulation software.
12. ADC/DAC: Design and study of Analog to Digital Converter.
13. Design and study of Digital to Analog Converter.

Course Outcome

At the end of this course students will demonstrate the ability to:

1. Understand the characteristics of transistors.
2. Design and analyze various configurations of amplifier circuits.
3. Design sinusoidal and non-sinusoidal oscillators.
4. Understand the functioning of OP-AMP and design OP-AMP based circuits.
5. Design ADC and DAC.

KEC453	Signal System Lab	0L:0T:2P	1 Credits

SUGGESTIVE LIST OF EXPERIMENTS

1. Introduction to MATLAB
    a. To define and use variables and functions in MATLAB.
    b. To define and use Vectors and Matrices in MATLAB.
    c. To study various MATLAB arithmetic operators and mathematical functions.
    d. To create and use m-files.
2. Basic plotting of signals
    a. To study various MATLAB commands for creating two and three dimensional plots.
    b. Write a MATLAB program to plot the following continuous time and discrete time signals.
        i. Step Function
        ii. Impulse Function
        iii. Exponential Function
        iv. Ramp Function
        v. Sine Function
3. Time and Amplitude transformations
   Write a MATLAB program to perform amplitude-scaling, time-scaling and time-shifting on a given signal.
4. Convolution of given signals
   Write a MATLAB program to obtain linear convolution of the given sequences.
5. Autocorrelation and Cross-correlation
    a. Write a MATLAB program to compute autocorrelation of a sequence x(n) and verify the property.
    b. Write a MATLAB program to compute cross-correlation of sequences x(n) and y(n) and verify the property.
6. Fourier Series and Gibbs Phenomenon
    a. To calculate Fourier series coefficients associated with Square Wave.
    b. To Sum the first 10 terms and plot the Fourier series as a function of time.
    c. To Sum the first 50 terms and plot the Fourier series as a function of time.
7. Calculating transforms using MATLAB
    a. Calculate and plot Fourier transform of a given signal.
    b. Calculate and plot Z-transform of a given signal.
8. Impulse response and Step response of a given system
    a. Write a MATLAB program to find the impulse response and step response of a system form its difference equation.
    b. Compute and plot the response of a given system to a given input.
9. Pole-zero diagram and bode diagram
    a. Write a MATLAB program to find pole-zero diagram, bode diagram of a given system from the given system function.
    b. Write a MATLAB program to find, bode diagram of a given system from the given system function.
10. Frequency response of a system
    Write a MATLAB program to plot magnitude and phase response of a given system.

11. Checking linearity/non-linearity of a system using SIMULINK

a. Build a system that amplifies a sine wave by a factor of two.
b. Test the linearity of this system using SIMULINK.

Course outcomes:

At the end of this course students will demonstrate the ability to:

1. Understand the basics operation of MATLAB.
2. Analysis the time domain and frequency domain signals.
3. Implement the concept of Fourier series and Fourier transforms.
4. Find the stability of system using pole-zero diagrams and bode diagram.
5. Design frequency response of the system.

EVALUATION SCHEME

B.TECH. ELECTRONICS ENGINEERING, ELECTRONICS & COMMUNICATION ENGINEERING, ELECTRONICS & TELECOMMUNICATION ENGINEERING

YEAR 4rd/ SEMESTER VII

Sr. No.	Sub Code	Subject Name	Dept.	L-T-P	Th/Lab Marks	Sessional		Subject Total	Credit
					ESE	CT	TA		
1		Open Elective-I**	Other Dept.	3--0--0	70	20	10	100	3
2		Departmental Elective-III	Core Deptt.	3--0--0	70	20	10	100	3
3		Departmental Elective-IV	Core Deptt.	3--1--0	70	20	10	100	4
4	REC701	Data Communication Networks	Core Deptt.	3--1--0	70	20	10	100	4
5	REC702	VLSI Design	Core Deptt.	3--0--0	70	20	10	100	3
6	REC751	Optical Communication Lab	Core Deptt.	0--0--2	50	-	50	100	1
7	REC752	Electronics Circuit Design Lab	Core Deptt.	0--0—2	50	-	50	100	1
8	REC753	Industrial Training Viva-Voce	Core Deptt.	0--0—3	-	-	100	100	2
9	REC754	Project I	Core Deptt.	0--0--6	-	-	200	200	3
	TOTAL				450	100	450	1000	24

LIST OF DEPTT. ELECTIVES:

Elective – III REC 07* Departmental Elective III

1. REC070 Optical Network
2. REC071 Information Theory & Coding
3. REC072 Digital Image Processing
4. REC073 Advance Programming in Engineering

Elective – IV REC 07* Departmental Elective IV

1. REC075 Optical Communication
2. REC076 Filter Design
3. REC077 Applied Fuzzy Electronic Systems
4. REC078 Computerized Process Control

EVALUATION SCHEME

B.Tech. Electronics Engineering, Electronics & Communication Engineering, Electronics & Telecommunication Engineering

YEAR 4rd/ SEMESTER VIII

Sr. No	Sub Code	Subject Name	Dept.	L-T-P	Th/LAB Marks	Sessional		Subject Total	Credit
					ESE	CT	TA		
1		Open Elective-II**	Other Dept.	3-0-0	70	20	10	100	3
2		Departmental Elective-V	Core Deptt.	3-1-0	70	20	10	100	4
3		Departmental Elective-VI	Core Deptt.	3-0-0	70	20	10	100	3
4	REC851	Seminar	Core Deptt.	0-0-3			100	100	2
5	REC852	Project II	Core Deptt.	0-0-12	350	-	250	600	12
	TOTAL				560	60	380	1000	24

LIST OF DEPTT. ELECTIVES:

Elective – IV REC 08* Departmental Elective V

1. REC080 Electronic Switching
2. REC081 Analytical Instrumentation
3. REC082 Advanced Display Technologies & Systems
4. REC083 Satellite & RADAR systems

Elective – VI REC 08* Departmental Elective VI

1. REC085 Wireless & Mobile Communication)
2. REC086 Voice Over IP
3. REC087 Speech Processing
4. REC088 Micro and Smart Systems

REC701 DATA COMMUNICATION NETWORKS

COURSE OBJECTIVE: After completion of the course student will be able to:

1. Understand basic terminology of networking.
2. Evaluate the functions of various layers and their roles.

COURSE OUTCOME: After completion of the course student will be able to

CO1	Identify the issues and challenges in the architecture of a network.
CO2	Understand the ISO/OSI seven layers in a network.
CO3	Realize protocols at different layers of a network hierarchy
CO4	Recognize security issues in a network.

DATA COMMUNICATION NETWORKS		**3 1 0**
Unit	**Topic**	**Lectures**
I	Introduction to Networks and Data Communications, Goals and Applications of Networks, Network structure and architecture, The Internet, Protocols and Standards, Layered Tasks, The OSI reference model, TCP / IP, Addressing, Line Coding Review.	8
II	Physical Layer, Transmission Media: Guided and unguided, Network Topology Design, Data Link Layer: Error detection and Correction, Framing, Flow and Error Control Protocols, Networking devices.	8
III	Multiple Access: Random Access Protocols, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16	8
IV	Network Layer: Point - to Pont Networks routing, Congestion control Internetworking -TCP / IP, IP packet, IPV4, IPv6, Transport Layer Protocol: UDP and TCP, ATM, session Layer-Design issues	8
V	Application Layer: File Transfer, Electronic mail, Virtual Terminals, Cryptography, Network Security	8

Text Book:

1. Forouzan, Data Communication & Networking, McGrawhill Education
2. Lathi, B. P. & Ding, Z., (2010), Modern Digital and Analog Communication Systems,Oxford University Press
3. Stallings, W., (2010), Data and Computer Communications, Pearson.
4. Andrew S. Tanenbaum, “Computer Networks” Pearson.
5. Ajit Pal, “Data Communication and Computer Networks”, PHI
6. Dimitri Bertsekas, Robert G. Gallager, “Data Networks”, Prentice Hall, 1992

REC702 VLSI DESIGN

COURSE OBJECTIVE:

1. To learn basic CMOS Circuits.
2. To learn CMOS process technology.
3. To learn techniques of chip design using programmable devices.
4. To learn the concepts of designing VLSI Subsystems.
5. To learn the concepts of modelling a digital system using Hardware Description Language.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Model the behaviour of a MOS Transistor
CO2	Design combinational and sequential circuits using CMOS gates
CO3	Identify the sources of power dissipation in a CMOS circuit.
CO4	Analyse SRAM cell and memory arrays

VLSI DESIGN		**3 0 0**
Unit	**Topics**	**Lectures**
I	Introduction: A Brief History, Preview, MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Logic Design, Circuit Design, Physical Design, Design Verification, Fabrication, Packaging and Testing.	8
II	Delay: Introduction, Transient Response, RC delay model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models. Power: Introduction, Dynamic Power, Static Power	8
III	Energy – Delay Optimization, Low Power Architectures. Interconnect: Introduction, Interconnect Modelling, Interconnect Impact, Interconnect Engineering, Logical Effort with Wires	8
IV	Dynamic logic circuits: Introduction, basic principle of pass transistor circuits, synchronous dynamic circuit techniques, dynamic CMOS circuit techniques, domino CMOS logic. Semiconductor memories: Introduction, DRAM, SRAM, ROM, flash memory.	8
V	Low – Power CMOS Logic Circuits: Introduction, Overview of Power Consumption, Low – Power Design through voltage scaling, Estimation and Optimization of switching activity, Reduction of Switched Capacitance and Adiabatic Logic Circuits. Design for Testability: Introduction, Fault Types and Models, Controllability and Observability, Ad Hoc Testable Design Techniques, Scan Based and BIST Techniques	8

Text Book:

1. Sung-Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis & Design",Mcgraw Hill, 4th Edition.
2. Neil H.E.Weste, David Money Harris, "CMOS VLSI Design – A circuits and SystemsPerspective" Pearson, 4th Edition

Reference Books:

1. D. A. Pucknell and K. Eshraghian, "Basic VLSI Design: Systems and Circuits", PHI, 3rd Ed.,1994.

2. W.Wolf, Modern VLSI Design: System on Chip, Third Edition, Pearson, 2002.

DEPARTMENT ELECTIVES - III

REC070 OPTICAL NETWORK

COURSE OBJECTIVES:

1. To make students familiar with Optical Network.
2. To choose system components.
3. To identify the networks.
4. To identify the WDM Network Design.
5. As a prerequisite for the course in Wireless LANs Optical Switching.

COURSE OUTCOME: After completion of the course student will be able to

CO1	Familiarize with multiplexing techniques, second generation optical networks, The optical layer, optical packet switching.
CO2	Understand the concept of Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation.
CO3	Understand the basics of Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure.
CO4	To gain knowledge of Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability.
CO5	To gain knowledge of working of OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network.

OPTICAL NETWORK		**3 0 0**
Unit	**Topic**	**Lectures**
I	Introduction to Optical Network:- Optical Networks: multiplexing techniques, second generation optical networks. The optical layer, optical packet switching. Transmission Basics: wavelength, frequencies and channel spacing, wavelength standards. Non linear Effects: Effective length and area, stimulated brillouin scattering, stimulated raman scattering, Propagation in a non linear medium, self phase modulation, cross phase modulation Four wave mixing	8
II	Components:-Couplers: Principles of operation, Conservation of energy, Isolators and circulators: Principles of operation Multiplexers and filters: Gratings, diffraction pattern, Bragg grating, Fiber gratings, Fabry-perot filters, multilayers dielectric thin – film filters, Mach-Zehnder interferometers, Arrayed waveguide grating, Acousto-optic tunable filter, High channel count multiplexer Architecture. Switching : large optical switches, Optical switch Technologies, large electronic switches wavelength converters: Optoelectronic Approch , optical grating, interferometric techniques wave mixing. Crosstalk: Intra-channel crosstalk, inter-channel crosstalk, crosstalk in Networks, Bidirectional system crosstalk reduction.	8
III	Networks- SONET/SDH: Multiplexing, SONET/SDH layers, SONET Frame structure, SONET/SDH physical layer, Elements of a SONET/SDH infrastructure. ATM: Function of ATM, Adaptation layers, Quality of service.	8

	IP: Routing and forwarding, QOS, WDM Network elements: Optical line terminals, Optical line amplifiers,. Optical add/Drop multiplexers: Architecture, reconfigurable OADMS, Optical cross connects: All optical OXC configuration	
IV	WDM Network Design Cost Trade-offs, Light path Topology Design, and Routing and wavelength assignment problems, Dimensioning Wavelength Routing Networks, Network Survivability, Basic Concepts, Protection in SONET/SDH, Protection in client layer, Optical Layer Protection, Different Schemes, Interworking between Layers, Access Networks, Network Architecture Overview, Enhanced HFC, FTTC, PON evolution	8
V	Optical Switching, OTDM, Synchronization, Header Processing, Buffering, Burst Switching, Deployment Considerations- SONET/SDH core Network	8

Text Books:

1. R. Ramaswami, & K. N. Sivarajan, "Optical Networks a Practical perspective",Morgan Kaufmann Publishers, 3rd Ed.
2. U. Black, "Optical Networks: Third Generation Transport Systems"/ PearsonEducations

Reference Books:

1. Biswanath Mukherjee "Optical WDM Networks" Springer Pub 2006

REC071 INFORMATION THEORY & CODING

COURSE OBJECTIVE:

1. To learn basic of Entropy.
2. To learn Asymptotic Equipartition Property.
3. To learn Channel Capacity.
4. To learn the implementation of Block Codes
5. To learn the Convolution codes

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Model the Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information
CO2	Design Data Compression, Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length
CO3	Identify the Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem.
CO4	Analyse Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes
CO5	Design Generator matrices for convolutional codes, Generator polynomials for convolutional codes

INFORMATION THEORY & CODING		**3 0 0**
Unit	**Topics**	**Lectures**
I	**Entropy**: Entropy, Joint Entropy and Conditional Entropy, Relative Entropy and Mutual Information, Relationship Between Entropy and Mutual Information, Chain Rules for Entropy, Relative Entropy, and Mutual Information, Jensen's Inequality and Its Consequences, Log Sum Inequality and Its Applications, Data-Processing Inequality, Sufficient Statistics, Fano's Inequality	8
II	**Asymptotic Equipartition Property:** Asymptotic Equipartition Property Theorem, **Consequences of the AEP:** Data Compression, High-Probability Sets and the Typical Set Data Compression: Examples of Codes, Kraft Inequality, Optimal Codes, Bounds on the Optimal Code Length, Kraft Inequality for Uniquely Decodable Codes, Huffman Codes, Some Comments on Huffman Codes, Optimality of Huffman Codes, Shannon–Fano–Elias Coding	8
III	**Channel Capacity:** Examples of Channel Capacity, Symmetric Channels, Properties of Channel Capacity, Preview of the Channel Coding Theorem, Definitions, Jointly Typical Sequences, Channel Coding Theorem	8
IV	**Block** Codes Digital communication channel, Introduction to block codes, Single-parity-check codes, Product codes, Repetition codes, Hamming codes, Minimum distance of block codes, Soft-decision decoding, Automatic-repeat-request	8

	schemes **Linear codes** Definition of linear codes, Generator matrices, Standard array, Parity-check matrices, Error	
V	**Convolution codes** Encoding convolutional codes, Generator matrices for convolutional codes, Generator polynomials for convolutional codes, Graphical representation of convolutional codes, Viterbi decoder	8

Text Books:

1. Bose, Inforrmation Theory, Coding and Cryptography, Mcgrawhill Education
2. Joy A. Thomas, Thomas M. Cover, "Elements of information theory", Wiley-Interscience; 2edition (July 18, 2006)
3. S. Gravano, "Introduction to Error Control Codes" OUP Oxford (24 May 2001)
4. Robert B. Ash, "Information Theory", Dover Publications (November 1, 1990)
5. Todd k Moon, "Error Correction Coding: Mathematical Methods and Algorithms " Wiley,2005

REC072 DIGITAL IMAGE PROCESSING

COURSE OBJECTIVE:

1. To study the image fundamentals and mathematical transforms necessary for image processing.
2. To study the image enhancement techniques
3. To study image restoration procedures.
4. To study the image compression procedures.
5. To study the image segmentation and representation techniques

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the need for image transforms and their properties
CO2	Choose appropriate technique for image enhancement both in spatial and frequency Domains.
CO3	Identify causes for image degradation and apply restoration techniques.
CO4	Compare the image compression techniques in spatial and frequency domains.
CO5	Select feature extraction techniques for image analysis and recognition.

DIGITAL IMAGE PROCESSING		**3 0 0**
Unit	**Topics**	**Lectures**
I	**Introduction:** Overview of Image Processing, Nature of Image Processing, Application area of image processing, Digital Image Representation, Types of images, Digital Image Processing Operations, Fundamental steps in DIP, Overview of Digital Image Systems, Physical Aspect of Image Acquisition, biological Aspect of Image Acquisition, sampling & quantization, Digital Halftone Process, Image storage and File formats.	8
II	**Image Transforms:** Need for image transforms, Properties of Fourier transform, Discrete cosine transform, Discrete sine transform, Hadamard transform, Haar transform, Slant transform, SVD and KL transforms, Comparison between transforms. **Image Enhancement:** Image Quality and Need for image enhancement, Image enhancement operations, Image enhancement in spatial domain, histogram based techniques, Spatial Filtering concepts, Image smoothing spatial filters, Image Sharpening spatial filters, Image smoothing in frequency domain filtering, Image sharpening in frequency domain, Homomorphism filtering.	8
III	**Image Restoration:** Introduction to degradation, Types of Image degradations, image degradation models, noise modeling, Estimation of degradation functions, Image restoration in presence of noise only, Periodic noise and band – pass and band reject filtering, difference between enhancement & restoration, Image restoration techniques	8
IV	**Image Compression:** Image compression model, Compression algorithms and its types, Type of redundancy, lossless compression algorithms, Lossy	8

	compression algorithms, Image and video compression standards	
V	**Image Segmentation:** Introduction, Detection of Discontinuities, Edge Detection, Hough Transforms and Shape Detection, corner detection, Principle of thresholding, Principle of region - growing.	8

Text Books:

1. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image Processing UsingMATLAB’’, Mc Graw Hill, 2nd Edition
2. Jayaraman, Digital Image Processing, McGrawhill Education
3. S. Sridhar, “Digital Image Processing”, OXFORD University Press, Second Edition.
4. Rafael C. Gonzalez Richard E woods Steven L. Eddins, ‘‘Digital Image’’, Pearson.
5. Anil K Jain, ‘’Fundamentals of Digital Image Processing”, Pearson.

REC073 ADVANCE PROGRAMMING IN ENGINEERING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand interactive computation techniques and learn algorithm development in Matlab.
2. To apply Matlab programming skills in communication engineering applications.
3. To apply Matlab programming skills in control system applications.
4. To apply Matlab application in neural networks and fuzzy logic.
5. To apply Matlab programming skills in digital signal processing applications.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the fundamentals of Matlab programming as well as understand and apply advance level programming techniques for solving problems using numerical methods.
CO2	Learn, apply, and investigate Matlab applications in advance communication systems.
CO3	Apply and investigate stability of systems and processes using time domain and frequency domain stability criterions like Routh-Hurwitz, State-space representation, Bode plots and Root Locus techniques.
CO4	Learn, apply, and investigate Matlab applications in neural networks and fuzzy logic.
CO5	Learn, apply, and investigate Matlab applications in digital signal processing including multi-rate DSP algorithms.

Advance Programming in Engineering 3 0 0

Unit	Topics	Lectures
I	Introduction of MATLAB, MATLAB fundamental, Interactive Computation: Logical vectors, logical operations, logical functions, Matrix and Arrays, matrices, matrix operations, MATLAB Graphics: Basics 2-D plots, 3-D plots, handle graphics, Saving and printing graphs, Linear equations. Loops, Error and Pitfalls. Program design and algorithm development, MATLAB scripts and functions and data import-export utilities.	8
II	MATLAB Applications in Communication Systems: Introduction, Generation and detection of AM, FM, and PM signals, Sampling of signals, Pulse modulation techniques (PAM, PWM, PPM), PCM, Digital modulation techniques (ASK, PSK, FSK, M-ary), OFDM, Spread-spectrum techniques	8
III	MATLAB Applications in control system: Introduction, Laplace and Inverse Laplace Transform, Transfer function, Zero, Poles and Pole – Zero map of a transfer function, State-Space representation, series/cascade, parallel and feedback Connections, Time response of control systems Routh Hurwitz Criteria. Root Locus, Frequency response Representation: Bode plots, Gain Margin, Phase Margin, Polar Plot, Nyquist Plot.	8
IV	MATLAB Application in Neural Networks: Introduction, salient features of artificial neural networks, ANN Architectures, Application using multilayer perceptron, ANN based control. MATLAB Application in Fuzzy Logic Systems: Introduction, Linguistic variables and membership functions, fuzzy operations, rule matrix, fuzzy inference systems, washing machine problem,	8

	fuzzy controller example (Water Bath).	
V	MATLAB Application in Digital Signal Processing: Introduction, signal and systems classification, operations on discrete-time signals, Multirate signal processing functions, convolution, Z- Transform, Discrete Fourier Transform, Fast Fourier Transform, Discrete Cosine Transform, Digital Filtrer Design.	8

Text Books:

1. Raj Kumar Bansal, Ashok Kumar Goel and Manoj Kumar Sharma, "MATLAB and its Applications in Engineering ", Pearson 14th impression,2014.
2. Brian H. Hahn and Daniel T. Valentine, "Essential MATLAB for Engineering and Scientists", Academic Press, Elsevier, 5th edition, 2013.
3. Rudra Pratap, "MATLAB- A quick introduction for Scientists and Engineers", Oxford University Press, 2013.
4. www.mathworks.com

DEPARTMENT ELECTIVES -IV

REC075 OPTICAL COMMUNICATION

COURSE OBJECTIVE:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion, SM fibers.
3. To learn the various optical sources, materials and fiber splicing.
4. To learn the fiber optical receivers and noise performance in photo detector.
5. To learn link budget, WDM, solitons and SONET/SDH network.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Familiarize with basic concepts and theory of Optical Communication
CO2	Demonstrate OPCOMM components, assemble them and solve problems on Optical Communication system
CO3	Able to design, implements, analyse and maintains optical communication system
CO4	Gain knowledge of different source of light as well as receiver and their comparative study
CO5	To get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain

OPTICAL COMMUNICATION **3 1 0**

Unit	Topic	Lectures
I	Overview of optical fiber communication: The general system, Advantages of optical fiber communication. Optical spectral band. Optical Fiber waveguides: Introduction, Ray theory transmission Total internal reflection, acceptance angle, numerical aperture, skew rays. Electromagnetic mode theory for optical propagation: Electromagnetic waves, modes in a planar guide, phase and group velocity, phase shift with total internal reflection and the evanescent field, goos hanchen shift.	10
II	Cylindrical Fiber: modes, mode coupling, step index fibers Graded index fibers, Single mode Fiber: Cut-off wavelength, Mode field diameter and spot size, effective refractive index, Group delay and mode delay factor, The Gaussian approximation, equivalent step index methods. Signal distortion in optical fibers - Attenuation, Material Absorption, losses in silica glass fibers; Intrinsic absorption, Extrinsic absorption. Linear scattering losses; Ray light scattering, Mie scattering. Non linear Scattering losses: fiber bending losses; Dispersion, Chromatic dispersion: material dispersion, waveguide dispersion. Intermodal dispersion: Multimode step index fiber, Multimode graded index fiber. Overall fiber dispersion Multimode fiber, Dispersion modified single mode fibers ,Dispersion–shifted fiber, dispersion flatted fibers, nonzero-dispersion-shifted fibers (MZ-DSF), Polarization: Fiber birefringence, polarization mode dispersion, polarization-maintaining fibers, Non-linear effects: Scattering effects, Kerr effects.	10
III	Optical sources - Light Emitting Diodes (LEDs): Structures, light source materials, Quantum Efficiency on LED Power Modulation of a LED, Laser Diodes- models and threshold conditions, laser diode rate equations, External	6

	quantum efficiency, resonant frequency, laser diode structures and radiation patterns, single mode lasers modulation of laser diodes, laser lines.	
IV	Source to fiber power launching, Source Output patterns, Power coupling calculation, Power launching versus wavelength, equilibrium numerical aperture. Photo detectors: Physical principles of photodiodes: The PIN photo detector, Avalanche photodiodes. Photo detector Noise: Noise sources, signal to noise ration. Detector Response time: Depletion layer photocurrent, response time structure of in GaAs APDs, Temperature effect on Avalanche gain, comparison of photo detectors	6
V	Optical receiver operation: Fundamental receiver operation: Digital signal transmission, error sources, front end amplifier. Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern Features, BER and Q Factor Measurement Coherent Detection: Fundamental concepts, Homodyne detection, heterodyne detection, IBER comparisons. Digital links: Point to point links, power penalties.	8

Text Book:

1. Gerd Keiser, “Optical Fiber Communications”, McGraw Hill , 5th Edition, 2013.
2. John M. Senior, “Optical Fiber Communications”, PEARSON, 3rd Edition, 2010.

Reference Books:

1. Sanjay Kumar Raghuwanshi, Santosh Kumar, “Fiber Optical Communications”, University Press, 2018.
2. Govind P. Agrawal, “Fiber Optic Communication Systems”, John Wiley, 3rd Edition, 2004.
3. Oseph C. Plais, “Fiber Optic Communication”, Pearson Education, 4th Ed, 2004.

REC076 FILTER DESIGN

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand about the characteristics of different filters.
2. Understand the concept of Approximation Theory.
3. Learn about the switched capacitor filter.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Choose an appropriate transform for the given signal.
CO2	Choose appropriate decimation and interpolation factors for high performance filters.
CO3	Model and design an AR system.
CO4	Implement filter algorithms on a given DSP processor platform.

FILTER DESIGN		**3 1 0**
Unit	**Topics**	**Lectures**
I	Introduction: Fundamentals, Types of filters and descriptive terminology, why we use Analog Filters, Circuit elements and scaling, Circuit simulation and modelling. Operational amplifiers: Op-amp models, Op-amp slew rate, Operational amplifiers with resistive feedback: Noninverting and Inverting, Analysing Op-amp circuits, Block diagrams and feedback, The Voltage follower, Addition and subtraction, Application of Op-amp resistor circuits.	8
II	First order filter: Bilinear transfer functions and frequency response – Bilinear transfer function and its parts, realization of passive elements, Bode plots, Active realization, The effect of A(s), cascade design.	8
III	Second order low pass and band pass filters: Design parameters, Second order circuit, frequency response of low pass and band pass circuits, Integrators and others biquads.	8
IV	Second order filters with arbitrary transmission zeros: By using summing, By voltage feed forward, cascade design revisited. Low pass filters with maximally flat magnitude: the ideal low pass filter, Butterworth response, Butterworth pole locations, low pass filter specifications, arbitrary transmission zeros.	8
V	Low pass filter with equal ripple (Chebyshev) magnitude response: The chebyshev polynomial ,The chebyshev magnitude response, Location of chebyshev poles, Comparison of maximally flat & equal–ripple responses, Chebyshev filter design Inverse chebyshev and cauer filters: Inverse chebyshev response, From specifications to pole and zero locations, Cauer magnitude response, Chebyshev rational functions, Cauer filter design.	8

Text Book:

1. Rolf. Schaumann, Haiqiao Xiao, Mac. E. Van Valkenburg, “Analog Filter Design”, 2ndIndian Edition, Oxford University Press.

Reference Books:

1. J. Michael Jacob, “Applications and Design with Analog Integrated Circuits”,Second edition, Pearson.
2. T. Deliyannis, Yichuang Sun, J.K. Fidler, “Continuous-Time Active Filter Design”,CRC Press.

REC077 APPLIED FUZZY ELECTRONIC SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand Fuzzy Sets, Possibility Distributions.
2. To analysis Fuzzy Rule.
3. To Be aware of uncertainty in information.
4. To learn approximate method of Extension.
5. Analysis Fuzzy Logic in Control Engineering.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory.
CO2	Design Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models.
CO3	Realization of Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties.
CO4	Aware Principle of Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic.
CO5	Understand Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture.

APPLIED FUZZY ELECTRONIC SYSTEMS		**3 1 0**
Unit	**Topics**	**Lectures**
I	History of Fuzzy Logic, Fuzzy Sets, Possibility Distributions, Fuzzy Rules, Fuzzy Sets, Operations of Fuzzy Sets, Properties of Fuzzy Sets, Geometric Interpretations of Fuzzy Sets, Possibility Theory, Fuzzy Relations and their Compositions, Fuzzy Graphs, Fuzzy Numbers, Functions with Fuzzy Arguments, Arithmetic Operations of Fuzzy Numbers.	8
II	Fuzzy Rules: Fuzzy Mapping Rule, Fuzzy Implication Rule, Fuzzy Rule Based Models for Function Approximations, Theoretical Foundation of Fuzzy Mapping Rules, Types of Fuzzy Rule Based Models: Mamdani Model, TSK Model, Standard Additive Model, Fuzzy Implications and Approximate Reasoning: Propositional Logic, First Order Predicate Calculus, Fuzzy Implications, Approximate Reasoning, Criteria and Family of Fuzzy Implications, Possibility vs. Probability, Probability of Fuzzy Event, Probabilistic Interpretations of Fuzzy Sets, Fuzzy Measure.	8
III	Uncertainty in information; Classical Sets, Fuzzy Sets and their properties; Cardinality of Classical Relations and their properties, The a- Level Set, Cardinality of Fuzzy Relations and their properties; Composition; Tolerance and Equivalence relationship; Membership Functions; Fuzzification and Defuzzification process; Fuzzy to Crisp Conversions; Lambda cuts; Extension	8

	Principle, Crisp functions and its mapping, Fuzzy functions and its mapping; Fuzzy Numbers; Internal Analysis in Arithmetic	
IV	Approximate method of Extension, Vertex Method, DSW Algorithm, and Restricted DSW Algorithm and their comparison, Classical Predicate Logic; Fuzzy Logic; Approximate Reasoning; Fuzzy Tautologies, Contradictions, Equivalence, and Logical Proof; Fuzzy Rule Based Systems, Models of Fuzzy AND, OR, and Inverter; Fuzzy Algebra; Truth Tables; Fuzzy Functions; Concept of Fuzzy Logic Circuits; Fuzzy Flip- Flop; Fuzzy Logic Circuits in Current Mode, Furry Numbers.	8
V	Fuzzy Logic in Control Engineering: Fundamental Issues in Control Engineering, Control Design Process, Semiformal Aspects of Design Process, Mamdani Architecture of Fuzzy Control, The Sugeno-Takagi Architecture. Fuzzy Logic in Hierarchical Control Architecture, Historical Overview and Reflections on Mamdani`s Approach, Analysis of Fuzzy Control System via Lyapunov`s Direct Method, Linguistic Approach to the analysis of Fuzzy Control System, Parameter Plane Theory of Stability, Takagi-Sugeno-Kang Model Of Stability Analysis.	8

Text Book:

1. John Yen, Reza Langari, “Fuzzy Logic: Intellegent Control and Information”, PearsonPublication.
2. Ahmad M. Ibrahim, “Introduction to Applied Fuzzy Electronics”, Prentice Hall Publication.
3. Ahmad M. Ibrahim, “Fuzzy Logic for Embedded Systems Applications”, NewnesPublications.
4. Witold Pedrycz, Fernando Gomide, “Fuzzy Systems Engineering: Toward Human-CentricComputing”, John Wiley Publications.

REC078 COMPUTERISED PROCESS CONTROL

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Basics of Computer-Aided Process Control.
2. Analyse Industrial communication System.
3. Design Process Modelling for computerized Process control.
4. Design Advanced Strategies For Computerised Process control.
5. Analyse Computerized Process Control.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer.
CO2	Design Phase Locked Local Loop, Mixers. Time Division Multiplexed System – TDM/PAM system
CO3	Realize Process model, Physical model, Control Model. Modelling Procedure.
CO4	Formulate of Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.
CO5	Design Electric Oven Temperature Control, Reheat Furnace Temperature control.

COMPUTERISED PROCESS CONTROL		**3 1 0**
Unit	**Topic**	**Lectures**
I	Basics of Computer-Aided Process Control: Role of computers in process control, Elements of a computer aided Process control System, Classification of a Computer –Aided Process Control System Computer Aided Process–control Architecture: Centralized Control Systems, Distributed control Systems, Hierarchical Computer control Systems. Economics of Computer-Aided Process control. Benefits of using Computers in a Process control. Process related Interfaces: Analog Interfaces, Digital Interfaces, Pulse Interfaces, Standard Interfaces.	**8**
II	Industrial communication System: Communication Networking, Industrial communication Systems, Data Transfer Techniques, Computer Aided Process control software, Types of Computer control Process Software, Real Time Operating System	**8**
III	Process Modelling for computerized Process control: Process model, Physical model, Control Model, Process modelling. Modelling Procedure: Goals Definition, Information Preparation, Model Formulation, Solution Finding, Results Analysis, Model Validation	**8**
IV	Advanced Strategies For Computerised Process control: Cascade Control, Predictive control, Adaptive Control, Inferential control, Intelligent Control, Statistical control.	**8**
V	Examples of Computerized Process Control: Electric Oven Temperature Control, Reheat Furnace Temperature control, Thickness and Flatness control System for metal Rolling, Computer-Aided control of Electric Power Generation Plant.	**8**

Text Books:

1. S. K. Singh, “Computer Aided Process control”, PHI.

Reference Books:

1. C. L. Smith, “Digital computer Process Control”, Ident Educational Publishers.
2. C. D. Johnson, “Process Control Instrumentation Technology”, PHI.
3. Krishan Kant, “Computer Based Industrial Control”
4. Pradeep B. Deshpande & Raymond H. Ash, “ Element of Computer Process Control withAdvance Control Applications”, Instrument Society of America, 1981.
5. C. M. Houpis & G. B. Lamond, “Digital Control System Theory”, Tata McGraw Hill.

REC751 OPTICAL COMMUNICATION LAB

List of Experiments

1. To establish analog link using Optical Fiber.
2. To establish digital link using Optical Fiber.
3. To measure Propagation loss in optical fiber.
4. To measure bending loss in optical fiber.
5. To measure Numerical Aperture in optical fiber.
6. Time Division Multiplexing of signals using optical fiber.
7. Framimg in Time Division Multiplexing using optical fiber link.
8. To study the Manchester coding/Decoding used in optical fiber.
9. To study Voice Digitzation: A Law using optical fiber link.
10. To compare the effect of Electromagnetic Interference on a copper medium and on an optical fiber medium.

REC752 ELECTRONICS CIRCUIT DESIGN LAB

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand the concept ofuniversal op-amp based biquad.
2. To analyseamplitude control or stabilization applied to any sinusoidal oscillators and Op-amp/ OTA based function generator.
3. To design log/antilog circuits and find applications of analog multiplier/ divider.
4. To learn digital system design and its hardware implementation using TTL/ CMOS ICs and Any circuit idea using 555 Timer.
5. To design the circuit, Make hardware and measure various parameters and Simulation in Spice of the designed circuit.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand Universal op-amp based biquad.
CO2	Identify amplitude control or stabilization applied to any sinusoidal oscillators and Op-amp/ OTA based function generator.
CO3	Design log/antilog circuits and identify applications of analog multiplier/ divider.
CO4	Understand digital system design and its hardware implementation using TTL/ CMOS ICs and any circuit idea (not studied in the course) using 555 Timer in conjunction with any otherICs.
CO5	Design the circuit, Make hardware and measure various parameters and Simulation in Spice of the designed circuit.

In this practical course students will carry out a design oriented project work using various analog/ digital building blocks which they have already studied in their analog electronic/ digital electronic courses such as Electronic circuits, integrated circuits and filter design. The project may include but not restricted to any of the following:

1. Universal op-amp based biquad.
2. Universal OTA biquad.
3. Amplitude control or stabilization applied to any sinusoidal oscillators.
4. Op-amp/ OTA based function generator.
5. Any application of log/antilog circuits.
6. Any applications of analog multiplier/ divider.
7. Any digital system design and its hardware implementation using TTL/ CMOS ICs.
8. Any circuit idea (not studied in the course) using 555 Timer in conjunction with any otherICs.

The above must include:

1. Design the circuit.
2. Make hardware and measure various parameters.
3. Simulation in Spice of the designed circuit.
4. Comparison of measured and simulated results.

A report is to be made for evaluation.

DEPARTMENT ELECTIVES -V

REC080 ELECTRONIC SWITCHING

COURSE OBJECTIVE: Student will be able to:

1. Attain knowledge about analog and digital electronic switching.
2. Estimate traffic congestion in any telecom network.
3. Learn about call processing functions and various signalling schemes.
4. Gain the knowledge of packet switching, ATM and Banyan network switch.

COURSE OUTCOMES:

CO1	Describe and apply fundamentals of telecommunication systems and associated technologies.
CO2	Solve problems and design simple systems related to tele-traffic and trunking efficiency.
CO3	Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.
CO4	Understand the principles of the internal design and operation of telecommunication switches, and the essence of the key signalling systems that are used in telecommunication networks.

ELECTRONIC SWITCHING		**3 1 0**
Units	**Topic**	**Lectures**
I	Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register-transistor-senders, Distribution frames, Crossbar switch, A general trucking, Electronic switching, Reed- electronic system, Digital switching systems.	8
II	Digital Switching: Switching functions, Space Division Switching, Time Division Switching, Two-Dimensional Switching, Digital Cross-Connect Systems , Digital Switching in an Analog Environment	8
III	Telecom Engineering: Network Traffic Load and Parameters, Grade of Service and Blocking Probability, Modeling Switching Systems, Incoming Traffic and Service Time Characterization, Blocking models and Loss Estimates, Delay Systems	8
IV	Control of switching systems: Introduction, Call-processing functions, Common control, Reliability, availability and security; Stored-program control. Signalling: Introduction, Customer line signalling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signalling, Inter-register signalling, Common-channel signalling principles, CCITT signalling system no. 6 and 7, Digital customer line signalling.	8

V	Packet Switching: Packet Switching, Statistical Multiplexing, Routing Control (dynamic routing, virtual circuit routing and fixed-path routing), Flow Control, X.25, Frame Relay, TCP/IP ATM Cells, ATM Service Categories, ATM Switching (ATM Memory Switch, Space-Memory Switch, Memory-Space Switch, Memory-Space-Memory switch, Banyan Network Switch).	8

Text Books:

1. Thiagarajan Viswanathan & Manav Bhatnagar, "Telecommunication Switching Systems andNetworks", PHI.
2. J.E. Flood, "Telecommunication Switching, Traffic and Networks", Pearson Education.
3. John C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed.

REC081 ANALYTICAL INSTRUMENTATION

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand UV – Visible Spectroscopy.
2. Understand Infrared Spectroscopy.
3. Learn working of flame photometers.
4. Interpret working of mass Spectrometers.
5. Be aware of Nuclear Magnetic Resonance (NMR) Spectroscopy.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters.
CO2	Design basic components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques.
CO3	Learnprinciple, constructional details of flame photometers, types of flame photometers, types of flame photometers.
CO4	Be aware of Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer.
CO5	Understand the Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer

ANALYTICAL INSTRUMENTATION		**3 1 0**
Unit	**Topics**	**Lectures**
I	UV – Visible Spectroscopy: Introduction, Electromagnetic Radiation, Laws relating to absorption radiation, Absorption Instruments, Ultraviolet and visible absorption spectroscopy, Calorimeters, Double Beam spectrophotometer (Optical Diagram & Block Diagram) Microprocessor based Spectrophotometer (Block Diagram)	8
II	Infrared Spectroscopy, Basic Components of IR Spectrophotometers, Type of Infrared Spectrophotometers, Sample Handling Techniques	8
III	Flame photometers: principle, constructional details of flame photometers, types of flame photometers, types of flame photometers, clinical flame photometers, accessories for flame photometer, expression for concentration, interferences in flame photometry, procedure for determinations. Atomic Absorption Spectrometers: Atomic Absorption Spectroscopy, Atomic Absorption Instrumentation, Sources of interferences, meter scale.	8
IV	Mass Spectrometers: Basic Mass Spectrometer, Principle of operation, Type of Mass Spectrometers, components of Mass Spectrometers, inductively coupled plasma-mass spectrometer, trapped ion analyzers, ion cyclotron resonance (ICR) mass spectrometer, quadruple ion trap mass spectrometer, applications of mass spectrometry, gas chromatograph-mass spectrometer, liquid chromatograph-mass spectrometer, tandem mass spectrometry (MS/MS)	8

V	Nuclear Magnetic Resonance (NMR) Spectroscopy, Principle of NMR, types of NMR spectrometers, constructional details of NMR spectrometer, variation T-60A NMR spectrometer, sensitivity enhancement for analytical NMR-spectroscopy, Fourier transform NMR spectroscopy.	8

Text Books:

1. DA Skoog, "Principles of Instrumental Analysis," 6th Ed. Cengage
2. R. S. Kandpur, "Handbook Of Analytical Instruments", Mc Graw Hill 3rdEdition,
3. Willard, Merritt, Dean and Settle, "Instrumental Methods of Analysis", 7thEdition, CBS Publishers.

REC082 ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understandproperties of light.
2. To analyseDisplay Glasses, Inorganic Semiconductor TFT Technology.
3. To compare Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays.
4. To differentiate between Paper like and Low Power Displays.
5. To analyseMicro-display Technologies.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception.
CO2	Understand Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays.
CO3	Understand Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays
CO4	Be aware ofColorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Autostereoscopic 3-D Technology
CO5	Understand Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology.

ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS		**3 1 0**
Unit	**Topic**	**Lectures**
I	Properties of Light, Geometric Optics, Optical Modulation; Vision and Perception: Anatomy of Eye, Light Detection and Sensitivity, Spatial Vision and Pattern Perception, Binocular Vision and Depth Perception; Driving Displays: Direct Drive, Multiplex and Passive Matrix, Active Matrix Driving, Panel Interfaces, Graphic Controllers, Signal Processing Mechanism; Power Supply: Fundamentals, Power Supply Sequencing.	8
II	Display Glasses, Inorganic Semiconductor TFT Technology, Organic TFT Technology; Transparent Conductors, Patterning Processes: Photolithography for Thin Film LCD, Wet Etching, Dry Etching; Flexible Displays: Attributes, Technologies Compatible with Flexible Substrate and Applications, TFT Signal Processing Techniques; Touch Screen Technologies: Introduction, Coatings, Adhesive, Interfaces with Computer Mechanism.	8
III	Inorganic Phosphors, Cathode Ray Tubes, Vacuum Florescent Displays, Filed Emission Displays; Plasma Display Panels, LED Display Panels; Inorganic Electroluminescent Displays: Thin Film Electroluminescent Displays, AC Powder Electroluminescent Displays; Organic Electroluminescent Displays: OLEDs, Active Matrix for OLED Displays; Liquid Crystal Displays: Fundamentals and Materials, Properties of Liquid	8

	Crystals, Optics and Modeling of Liquid Crystals; LCD Device Technology: Twisted Numeric and Super twisted Numeric Displays, Smectic LCD Modes, In-Plane Switching Technology, Vertical Aligned Nematic LCD Technology, Bi-stable LCDs, Cholesteric Reflective Displays; LCD Addressing, LCD Backlight and Films, LCD Production, Flexoelectro-Optic LCDs.	
IV	Paper like and Low Power Displays: Colorant Transposition Displays, MEMs Based Displays, 3-D Displays, 3-D Cinema Technology, Auto-stereoscopic 3-D Technology, Volumetric and 3-D Volumetric Display Technology, Holographic 3-D Technology; Mobile Displays: Trans-reflective Displays for Mobile Devices, Liquid Crystal Optics for Mobile Displays, Energy Aspects of Mobile Display Technology.	8
V	Micro display Technologies: Liquid Crystals on Silicon Reflective Micro-display, Trans missive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology; Micro-display Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multi-focus Displays, Occlusion Displays, Cognitive Engineering and Information Displays; Display Metrology, Standard Measurement Procedures, Advanced Measurement Procedures: Spatial Effects, Temporal Effects, Viewing Angle, Ambient Light; Display Technology Dependent Issues, Standards and Patterns, Green Technologies in Display Engineering.	8

Text Book:

1. Janglin Chen, Wayne Cranton, Mark Fihn , “Handbook of Visual Display Technology”,Springer Publication.

REC083 SATELLITE & RADAR SYSTEMS

COURSE OBJECTIVE: After completion of the course student will be able to:

1. Become familiar with satellites and satellite services.
2. Understand satellite orbits and launching.
3. Identify earth segment and space segment components.
4. Identify satellite access by various users.
5. Study DTH and compression standards.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the orbital and functional principles of satellite communication systems
CO2	Architect, interpret, and select appropriate technologies for implementation of specified satellite communication systems
CO3	Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
CO4	Select an appropriate modulation, multiplexing, coding and multiple access schemes for a given satellite communication link.
CO5	Specify, design, prototype and test analog and digital satellite communication systems as per given specifications.

SATELLITE & RADAR SYSTEMS		**3 1 0**
Unit	**Topics**	**Lectures**
I	Elements of Satellite Communication, Orbital mechanics, look angle and orbit determination, launches and lauch vehicle, orbital effects, Introduction to geo-synchronous and geo-stationary satellites.	8
II	Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Introduction to satellite link design, basic transmission theory, system noise temperature and G/T ratio, design of down link and uplink, design of satellite links for specified C/N, satellite data communication protocols.	8
III	Direct broadcast satellite television and radio, satellite navigation and the global positioning systems, GPS position location principle, GPS receivers and codes, Satellite Signal Acquisition, GPS navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation.	8
IV	Introduction to radar, radar block diagram and operation, 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 fluctuations, Transmitter Power, Pulse Reception Frequency , Antenna Parameters, System Losses.	8
V	Tracking Radar: sequential lobbing, conical scan, mono-pulse Tracking, low angle tracking, tracking in range. MTI and Pulse Doppler Radar: Introduction to Doppler and MTI Radar, Delay Line cancellers, Staggered Pulse Reception Frequencies, Doppler Filter Banks, Digital MTI Processing, Moving Target Detector, Limitations to MTI Performance.	8

Text / Reference Books:

1. Merrill I. Skolnik “Introduction to Radar Systems”, Mc Graw- Hill.
2. J.C.Toomay, Paul J. Hannen “Principles of Radar”, PHI Learning.
3. B.Pratt, A.Bostian, “Satellite Communications”, Wiley India.
4. D. Roddy, “Satellite Communications”, McGrawhill Education.

DEPARTMENT ELECTIVES –VI

REC085 WIRELESS & MOBILE COMMUNICATION

COURSE OBJECTIVES:

1. To make students familiar with fundamentals of mobile communication systems.
2. To choose system (TDMA/FDMA/CDMA) according to the complexity, installation cost, speed of transmission, channel properties etc.
3. To identify the requirements of mobile communication as compared to static communication.
4. To identify the limitations of 2G and 2.5G wireless mobile communication and use design of 3G and beyond mobile communication systems.
5. To identify various modern wireless technologies.

COURSE OUTCOME: After completion of the course student will be able to

CO1	Familiarize with various generations of mobile communications.
CO2	Understand the concept of cellular communication.
CO3	Understand the basics of wireless communication.
CO4	Understand GSM mobile communication standard, its architecture, logical channels, advantages and limitations.
CO5	Gain knowledge of IS-95 CDMA mobile communication standard, its architecture, logical channels, advantages and limitations.
CO6	Gain knowledge of 3G mobile standards and their comparison with 2G technologies.

Wireless & Mobile Communication		**3 0 0**
Unit	**Topic**	**Lectures**
I	Evolution of mobile radio communication fundamentals. General Model of Wireless Communication Link, Types of Signals, Cellular Infrastructure, Cellular System Components, Antennas for Cellular Systems, Operation of Cellular Systems, Channel Assignment, Frequency reuse, Channel Assignment strategies, Handoff Strategies Cellular Interferences, Sectorization; Wireless Channel and Radio Communication, Free Space Propagation Model, Channel Noise and Losses, Fading in Land Mobile Systems, Multipath Fading, Fading Effects on Signal and Frequency, Shadowing.	8
II	Wireless Channel Modeling: AWGN Channel, Rayleigh Channel, Rician Fading Channel, Nakagami Fading Channel, Ocumura and Hata Path Loss Model; Channel Modelling: Stochastic, Flat Fading, Wideband Time-Dispersive Channel Modelling. .	8
III	Theory of Vocoders, Types of Vocoders; Spread Spectrum Modulation, Pseudo-Noise Codes with Properties and Code Generation Mechanisms, DSSS and FHSS Systems, Time Hopping and Hybrid Spread Systems; Multicarrier Modulation Techniques. Zero Inter Symbol Interference Communication Techniques, Detection Strategies, Diversity Combining Techniques: Selection Combining, Threshold Combining, Equal Gain Combining, Maximum Ratio	8

	Combining; Spatial Diversity and Multiplexing in MIMO Systems, Channel Estimation. Equalization Techniques: Transversal Filters, Adaptive Equalizers, Zero Forcing Equalizers, Decision Feedback Equalizers, and related algorithms.	
IV	Multiplexing and Multiple Access: FDMA, TDMA, CDMA, OFDMA, SC-FDMA, IDMA Schemes and Hybrid Method of Multiple Access Schemes, RAKE Receiver; Multiple Access for Radio Packet Systems: Pure ALOHA, Slotted ALOHA, CSMA and their versions; Packet and Pooling Reservation Based Multiple Access Schemes.	8
V	GSM system for mobile Telecommunication, General Packet Radio Service, Edge Technology; CDMA 2000, Wireless Local Loop, IMT 2000 and UMTS, Long Term Evolution (LTE), Mobile Satellite Communication, Introduction to Mobile Adhoc Networks, Li-Fi Communication, Ultra-Wideband Communication, Mobile data networks, Wireless Standards IMT 2000, Introduction to 4G and concept of NGN.	8

Text Book:

1. T.S. Rappaport, "Wireless Communication-Principles and practice", Pearson Publications,Second Edition.
2. Misra, Wireless Communication & Network: 3G & Beyond, McGraw Hill Education
3. Jaganathan, Principles of Modern Wireless Communication System, McGraw Hill Education
4. Upena Dalal, "Wireless Communication and Networks", Oxford Press Publications.
5. T L Singal ,"Wireless Communications ", McGraw Hill Education.

Reference Books:

1. Andrea Goldsmith, "Wireless Communications", Cambridge University Press.
2. S. Haykin & M. Moher, "Modern wireless communication", Pearson, 2005.

REC086 VOICE OVER IP

COURSE OBJECTIVE: Students undergoing this course are expected to :

1. Understand the basic principle of VoIP.
2. Understand the different signalling protocols.
3. Learn about how to improve the quality of service (VoIP).

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the characteristics of the Call signalling systems.
CO2	Design SIP Architecture.
CO3	Model and estimate media gateways.
CO4	Understand the network synchronization and management.
CO5	Evaluate the quality of service that need for QoS.

VOICE OVER IP		**3 0 0**
Unit	**Topics**	**Lectures**
I	**Introduction:** Carrier-Grade, VoIP, VoIP Challenges, Overview of the IP Protocol Suite, The Internet Protocol, IP Version 6, IP Multicast, The Transmission Control Protocol, The User Datagram Protocol, The Stream Control Transmission Protocol, The Real-Time Transport Protocol, The RTP Control Protocol, Security and Performance Optimization **Speech-Coding Techniques** A Little about Speech, Audio, and Music, Voice Sampling, Voice Quality, Types of Speech Coders, Waveform Coders, Analysis-by-Synthesis Codes, G.722–Wideband Audio	8
II	**Signaling Protocols:** H.323: Multimedia Conferencing over IP The H.323 Architecture, RAS Signaling, Call Signaling, Call Scenarios, H.245 Control Signaling, Conference Calls, Securing an H.323 Network. **The Session Initiation Protocol** The SIP Architecture, Overview of SIP Messaging Syntax, Examples of SIP Message Sequences, Redirect and Proxy Servers, The Session Description Protocol, Usage of SDP with SIP, SIP Extensions and Enhancements, Usage of SIP for Features and Services, Interworking	8
III	**Distributed Gateways and the Softswitch Architecture** Separation of Media and Call Control, Softswitch Architecture, Protocol Requirements for Controlling Media Gateways, Protocols for Controlling Media Gateways, MGCP, MEGACOP/H.248.1.	8
IV	**VoIP and SS7** The SS7 Protocol Suite, SS7 Network Architecture, ISUP, Performance Requirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures	8
V	**Quality of Service** The Need for QoS, Overview of QoS Solutions, The Resource Reservation Protocol, DiffServ, Multiprotocol Label Switching, Combining QoS Solutions	8

Text Books:

1. Richard Swale, Daniel Collins," Carrier-Grade VoIP", McGraw-Hill Education 3rdEdition,2014.
2. Olivier Hersent, Jean Pierre Petit, David Gurle, "IP Telephony – Deploying Voice Over-IPProtocols", John Wiley & Sons Ltd, 2005

REC087 SPEECH PROCESSING

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand digital models for speech signals.
2. To analyse time domain methods of speech sampling.
3. To evaluate short time Fourier analysis.
4. To learn homomorphic speech processing.
5. To understand Linear Predictive Coding of Speech.

COURSE OUTCOME: After completion of the course student will be able to:

CO1	Understand the mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models.
CO2	Understand time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate.
CO3	Design of filter banks, implementation of filter bank summation method using FFT.
CO4	Evaluate homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing.
CO5	Understand basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations.

SPEECH PROCESSING		**3 0 0**
Unit	**Topics**	**Lectures**
I	Digital models for speech signals: Mechanism of speech production & acoustic phonetics, the acoustic theory of speech production, lossless tube models, and digital models for speech signals.	6
II	Time Domain methods of speech sampling: Time dependent processing of speech, short time energy and average magnitude, short time average zero crossing rate, discrimination between speech& silence, pitch period estimation using parallel processing, short time autocorrelation function & AMDF, pitch period estimation using autocorrelation function	10
III	Short time Fourier Analysis: Definition and properties, design of filter banks, implementation of filter bank summation method using FFT, spectrographic displays, pitch detection, analysis by synthesis phase, vocoder and channel vocoder.	8
IV	Homomorphic speech processing: Homomorphic system for convolution, complex cepstrum of speech, pitch detection using Homomorphic processing, formant estimation, Homomorphic vocoder	6
V	Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, the autocorrelation method, computation of the gain for the model, solution of LPC equations for auto correlation method, prediction error and normalized mean square error, frequency domain interpretation of mean squared prediction error relation of linear predictive analysis to lossless tube models, relation between various speech parameters, synthesis of speech from linear predictive parameters, application of LPC parameters.	10

Text Book:

1. R. L. Rabiner & R.W. Schafer, “Digital Processing of speech signals”, Pearson Education.
2. B. Gold and Nelson Morgon, “Speech and audio signal processing”, Wiley India Edition,2006.

REC088 MICRO AND SMART SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected to:

1. Understand Microsystems versus MEMS
2. Analyse micro sensors, actuators, systems and smart materials.
3. Evaluate Micromachining technologies.
4. To learn Modeling of solids in Microsystems.
5. Analysis Integration of micro and smart systems.
6.

COURSE OUTCOME : After completion of the course student will be able to:

CO1	Understand the Why miniaturization?, Microsystems versus MEMS, Why micro fabrication.
CO2	Design Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor.
CO3	Realizesilicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining.
CO4	Understand bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams
CO5	Understand integration of Microsystems and microelectronics, microsystems packaging, case studies of integrated Microsystems

MICRO AND SMART SYSTEMS		**3 0 0**
Unit	**Topics**	**Lectures**
I	Introduction, Why miniaturization?, Microsystems versus MEMS, Why micro fabrication?, smart materials, structures and systems, integrated Microsystems, applications of smart materials and Microsystems,.	8
II	Micro sensors, actuators, systems and smart materials: Silicon capacitive accelerometer, piezo-resistive pressure sensor, conductometric gas sensor, an electrostatic combo -drive, a magnetic micro-relay, portable blood analyzer, piezoelectric inkjet print head, micro-mirror array for video projection, smart materials and systems.	8
III	Micromachining technologies: silicon as a material for micro machining, thin film deposition, lithography, etching, silicon micromachining, specialized materials for Microsystems, advanced processes for micro fabrication.	8
IV	Modeling of solids in Microsystems: Bar, beam, energy methods for elastic bodies, heterogeneous layered beams, bimorph effect, residual stress and stress gradients, poisson effect and the anticlastic curvature of beams, torsion of beams and shear stresses, dealing with large displacements, In-plane stresses. Modelling of coupled electromechanical systems: electrostatics, Coupled Electro-mechanics: statics, stability and pull-in phenomenon, dynamics. Squeezed film effects in electro-mechanics.	8
V	Integration of micro and smart systems: integration of Microsystems and	8

	microelectronics, microsystems packaging, case studies of integrated Microsystems, case study of a smart-structure in vibration control. Scaling effects in Microsystems: scaling in: mechanical domain, electrostatic domain, magnetic domain, diffusion, effects in the optical domain, biochemical phenomena.	

Text book:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Atre, “Micro and smart systems”, Wiley India, 2010.