

ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech. V Semester Electronics and Communication Engineering

S. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KEC-501	Integrated Circuits	3	1	0	30	20	50		100		150	4
2	KEC-502	Microprocessor & Microcontroller	3	1	0	30	20	50		100		150	4
3	KEC-503	Digital Signal Processing	3	1	0	30	20	50		100		150	4
4	KEC-051-054	Department Elective-I	3	0	0	30	20	50		100		150	3
5	KEC-055-058	Department Elective-II	3	0	0	30	20	50		100		150	3
6	KEC-551	Integrated Circuits Lab	0	0	2				25		25	50	1
7	KEC-552	Microprocessor & Microcontroller Lab	0	0	2				25		25	50	1
8	KEC-553	Digital Signal Processing Lab	0	0	2				25		25	50	1
9	KEC-554	Mini Project/Internship **	0	0	2				50			50	1
10	KNC501/KNC502	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			NC
11		MOOCs (Essential for Hons. Degree)											
		Total										950	22

**The Mini Project or Internship (4weeks) conducted during summer break after IV Semester and will be assessed during Vth Semester.

Course Code

Course Title

Department Elective-I

KEC-051 Computer Architecture and Organization

KEC-052 Industrial Electronics

KEC-053 VLSI Technology

KEC-054 Advance Digital Design using Verilog

Department Elective-II

KEC-055 Electronics Switching

KEC-056 Advance Semiconductor Device

KEC-057 Electronics Measurement & Instrumentation

KEC-058 Optical Communication

**B.Tech. VI Semester
Electronics and Communication Engineering**

S. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1	KEC-601	Digital Communication	3	1	0	30	20	50		100		150	4
2	KEC-602	Control System	3	1	0	30	20	50		100		150	4
3	KEC-603	Antenna and Wave Propagation	3	1	0	30	20	50		100		150	4
4		Department Elective-III	3	0	0	30	20	50		100		150	3
5		Open Elective-I	3	0	0	30	20	50		100		150	3
6	KEC-651	Digital Communication Lab	0	0	2				25		25	50	1
7	KEC-652	Control System Lab	0	0	2				25		25	50	1
8	KEC-653	Elective Lab	0	0	2				25		25	50	1
9	KNC601/ KNC602	Constitution of India, Law and Engineering / Indian Tradition, Culture and Society	2	0	0	15	10	25		50			NC
10		MOOCs (Essential for Hons. Degree)											
		Total										900	21

Course Code

Course Title

Department Elective-III

KEC-061	Microcontroller & Embedded System Design
KEC-062	Satellite Communication
KEC-063	Data Communication Networks
KEC-064	Analog Signal Processing
KEC-065	Random Variables & Stochastic Process

Course Code

Elective Lab

KEC-653A	Measurement & Instrumentation Lab
KEC-653B	Cad for Electronics Lab
KEC-653C	Microcontroller & Embedded System Design Lab

B.Tech 3rd Year
V Semester
Syllabus

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-501	INTEGRATED CIRCUITS	3L:1T:0P	4 Credits
----------------	----------------------------	-----------------	------------------

Unit	Topics	Lectures
I	The 741 IC Op-Amp: General operational amplifier stages (bias circuit, the input stage, the second stage, the output stage, short circuit protection circuitry), device parameters, DC and AC analysis of input stage, second stage and output stage, gain, frequency response of 741, a simplified model, slew rate, relationship between ft and slew rate.	8
II	Linear Applications of IC Op-Amps: Op-Amp based V-I and I-V converters, instrumentation amplifier, generalized impedance converter, simulation of inductors. Active Analog filters: Sallen Key second order filter, Designing of second order low pass and high pass Butterworth filter, Introduction to band pass and band stop filter, all pass active filters, KHN Filters. Introduction to design of higher order filters.	8
III	Frequency Compensation & Nonlinearity: Frequency Compensation, Compensation of two stage Op-Amps, Slewing in two stage Op-Amp. Nonlinearity of Differential Circuits, Effect of Negative feedback on Nonlinearity. Non-Linear Applications of IC Op-Amps: Basic Log–Anti Log amplifiers using diode and BJT, temperature compensated Log-Anti Log amplifiers using diode, peak detectors, sample and hold circuits. Op-amp as a comparator and zero crossing detector, astable multivibrator & monostable multivibrator. Generation of triangular waveforms, analog multipliers and their applications.	4 8
IV	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, CMOS implementation of SR flip-flops, a simpler CMOS implementation of the clocked SR flip-flop, CMOS implementation of J-K flip-flops, D flip-flop circuits.	6
V	Integrated Circuit Timer: Timer IC 555 pin and functional block diagram, Monostable and Astable multivibrator using the 555 IC. Voltage Controlled Oscillator: VCO IC 566 pin and functional block diagram and applications. Phase Locked Loop (PLL): Basic principle of PLL, block diagram, working, Ex-OR gates and multipliers as phase detectors, applications of PLL.	6

Text Book:

1. Microelectronic Circuits, Sedra and Smith, 7th Edition, Oxford, 2017.
2. Behzad Razavi: Design of Analog CMOS Integrated Circuits, TMH

Reference Books:

1. Gayakwad: Op-Amps and Linear Integrated Circuits, 4th Edition Prentice Hall of India, 2002.
2. Franco, Analog Circuit Design: Discrete & Integrated, TMH, 1st Edition.
3. Salivahnan, Electronics Devices and Circuits, TMH, 3rd Edition, 2015
4. Millman and Halkias: Integrated Electronics, TMH, 2nd Edition, 2010

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

1. Explain complete internal analysis of Op-Amp 741-IC.
2. Examine and design Op-Amp based circuits and basic components of ICs such as various types of filter.
3. Implement the concept of Op-Amp to design Op-Amp based non-linear applications and wave-shaping circuits.
4. Analyse and design basic digital IC circuits using CMOS technology.
5. Describe the functioning of application specific ICs such as 555 timer ,VCO IC 566 and PLL.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-502	MICROPROCESSOR & MICROCONTROLLER	3L:1T:0P	4 Credits
----------------	---	-----------------	------------------

Unit	Topics	Lectures
I	Introduction to Microprocessor: Microprocessor architecture and its operations, Memory, Input & output devices, The 8085 MPU- architecture, Pins and signals, Timing Diagrams, Logic devices for interfacing, Memory interfacing, Interfacing output displays, Interfacing input devices, Memory mapped I/O.	8
II	Basic Programming concepts: , Flow chart symbols, Data Transfer operations, Arithmetic operations, Logic Operations, Branch operation, Writing assembly language programs, Programming techniques: looping, counting and indexing. Additional data transfer and 16 bit arithmetic instruction, Logic operation: rotate, compare, counter and time delays, 8085 Interrupts.	8
III	16-bit Microprocessors (8086): Architecture, Pin Description, Physical address, segmentation, memory organization, Addressing modes. Peripheral Devices: 8237 DMA Controller, 8255 programmable peripheral interface, 8253/8254 programmable timer/counter, 8259 programmable interrupt controller, 8251 USART and RS232C.	8
IV	8051 Microcontroller Basics: Inside the Computer, Microcontrollers and Embedded Processors, Block Diagram of 8051, PSW and Flag Bits, 8051 Register Banks and Stack, Internal Memory Organization of 8051, IO Port Usage in 8051, Types of Special Function Registers and their uses in 8051, Pins Of 8051. Memory Address Decoding, 8031/51 Interfacing With External ROM And RAM. 8051 Addressing Modes.	8
V	Assembly programming and instruction of 8051: Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming. Programming 8051 Timers. Serial Port Programming, Interrupts Programming, Interfacing: LCD & Keyboard Interfacing, ADC, DAC & Sensor Interfacing, External Memory Interface, Stepper Motor and Waveform generation.	8

Text Books:

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 6th Edition, Penram International Publication (India) Pvt. Ltd.,2013
2. D. V. Hall : Microprocessors Interfacing, TMH 3rd Edition,
3. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and McKinlay Rolin D., "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson, 2nd Edition,2006

Reference Books:

1. Kenneth L. Short, "Microprocessors and programmed Logic", 2nd Ed, Pearson Education Inc.,2003
2. Barry B. Brey, "The Intel Microprocessors, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, PentiumPro Processor, PentiumII, PentiumIII, Pentium IV, Architecture, Programming & Interfacing", Eighth Edition, Pearson Prentice Hall, 2009.
3. Shah Satish, "8051 Microcontrollers MCS 51 Family and its variants", Oxford,2010

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

1. Demonstrate the basic architecture of 8085.
2. Illustrate the programming model of microprocessors & write program using 8085 microprocessor.
3. Demonstrate the basics of 8086 Microprocessor and interface different external Peripheral Devices like timer, USART etc. with Microprocessor (8085/8086).
4. Compare Microprocessors & Microcontrollers, and comprehend the architecture of 8051 microcontroller
5. Illustrate the programming model of 8051 and implement them to design projects on real time problems.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-503	DIGITAL SIGNAL PROCESSING	3L:1T:0P	4 Credits
----------------	----------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	<p>Introduction to Digital Signal Processing: Basic elements of digital signal processing, advantages and disadvantages of digital signal processing, Technology used for DSP.</p> <p>Realization of Digital Systems: Introduction- basic building blocks to represent a digital system, recursive and non-recursive systems, basic structures of a digital system: Canonic and Non-Canonic structures. IIR Filter Realization: Direct form, cascade realization, parallel form realization, Ladder structures- continued fraction expansion of $H(z)$, example of continued fraction, realization of a ladder structure, design examples. FIR Filter Realization: Direct, Cascade, FIR Linear Phase Realization and design examples.</p>	8
II	<p>Infinite Impulse Response Digital (IIR) Filter Design: Introduction to Filters, Impulse Invariant Transformation, Bi-Linear Transformation, All- Pole Analog Filters: Butterworth and Chebyshev, Design of Digital Butterworth and Chebyshev Filters, Frequency Transformations.</p>	8
III	<p>Finite Impulse Response Filter (FIR) Design: Windowing and the Rectangular Window, Gibb's phenomenon, Other Commonly Used Windows (Hamming, Hanning, Bartlett, Blackmann, Kaiser), Examples of Filter Designs Using Windows. Finite Word length effects in digital filters: Coefficient quantization error, Quantization noise – truncation and rounding, Limit cycle oscillations-dead band effects.</p>	8
IV	<p>DFT & FFT: Definitions, Properties of the DFT, Circular Convolution, Linear Convolution using Circular Convolution, Decimation in Time (DIT) Algorithm, Decimation in Frequency (DIF) Algorithm.</p>	8
V	<p>Multirate Digital Signal Processing (MDSP): Introduction, Decimation, Interpolation, Sampling rate conversion: Single and Multistage, applications of MDSP- Subband Coding of Speech signals, Quadrature mirror filters, Advantages of MDSP.</p>	8

Text Books:

1. John G Prokias, Dimitris G Manolakis, Digital Signal Processing. Pearson , 4th Edition, 2007
2. Johnny R. Johnson, Digital Signal Processing, PHI Learning Pvt Ltd., 2009.
3. S. Salivahanan, A. Vallavaraj, Digital Signal Processing, TMH, 4th Edition 2017.
4. Oppenheim & Schafer, Digital Signal Processing. Pearson Education 2015
5. S.K. Mitra, 'Digital Signal Processing–A Computer Based Approach, TMH, 4th Edition.

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

1. Design and describe different types of realizations of digital systems (IIR and FIR) and their utilities.
2. Select design parameters of analog IIR digital filters (Butterworth and Chebyshev filters) and implement various methods such as impulse invariant transformation and bilinear transformation of conversion of analog to digital filters.
3. Design FIR filter using various types of window functions.
4. Define the principle of discrete Fourier transform & its various properties and concept of circular and linear convolution. Also, students will be able to define and implement FFT i.e. a fast computation method of DFT.
5. Define the concept of decimation and interpolation. Also, they will be able to implement it in various practical applications.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-051	Computer Architecture and Organization	3L:0T:0P	3 Credits
----------------	---	-----------------	------------------

Unit	Topics	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

Text Book:

1. John P Hayes "Computer Architecture and Organization", 3rd Edition McGraw Hill Publication. (2017)
2. M Morris Mano, "Computer System Architecture", 3rd Edition ,Pearson,. (2017)

Reference Books:

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization and Embedded Systems", McGraw Hill Publication. (2009)
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Elsevier Publication. (2007)

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

1. Discuss about the basic concepts of system design methodology and processor level design.
2. Explain the basics of processor and basic formats of data representation.
3. Perform fixed and floating point arithmetic operations.
4. Describe the basic concepts of control design and pipeline performance.
5. Explain the architecture and functionality of central processing unit.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-052	INDUSTRIAL ELECTRONICS	3L:0T:0P	3 Credits
----------------	-------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Introduction to Power Switching Devices: Description of working & constructional features, Switching Characteristics, ratings and Applications of Power Transistor, Power MOSFET, SCR, DIAC, TRIAC, IGBT and MCT.	8
II	SCR Performance and Applications: Protection of SCR, SCR Triggering and Commutation Circuits/Methods, Series and Parallel operation of SCR, two transistor model of SCR, , Describe Construction & Working of Opto- Isolators, Opto-TRIAC, Opto-SCR.	8
III	Power Converter Performance & Applications: Introduction to Basic Power Converters Architecture - Single Phase, there performance under different types of Loads, Average/RMS output Voltage & Current, Freewheeling Diode, Feedback Diode, State Relay using Opto SCR, SMPS and UPS functioning through Block Diagrams.	8
IV	Timers & Delay Elements, High Frequency Power Heating, Sensor and Actuators: RC Base Constant Timers, Timer Circuits using SCR, IC-555, Programmable Timer and their Industrial Applications, Induction Heating and Dielectric Heating System and Their Applications, Sensors, Transducers, and Transmitters for Measurement, Control & Monitoring : Thermoresistive Transducer, Photoconductive Transducers, Pressure Transducers, Flow Transducers, Level Sensors, Speed Sensing, Vibration Transducers, Variable-Frequency Drives, Stepper Motors and Servomotor Drives.	8
V	Automation and Control: Data Communications for Industrial Electronics, Telemetry, SCADA & Automation, AC & DC Drives, Voltage & Power Factor Control through Solid State Devices, Soft Switching, Industrial Robots.	8

Text Books:

1. M.H. Rashid, "Power Electronics: Circuits, Devices & Applications", Pearson, 4rd Edition, 2013.
2. P.C.Sen, "Power Electronics", McGraw Hill Education (India) Pvt. Ltd 2nd Ed, 2017
3. V.R. Moorthy, "Power Electronics: Devices, Circuits and Industrial Applications" Oxford University Press, 2007.
4. B. Paul, Industrial Electronic and Control, Prentice Hall of India Private Limited (2004).
5. Ned Mohan, T.M. Undeland and W.P. Robbins, "Power Electronics: Converters, Applications and Design", Wiley India Ltd, 2008.
6. P.S. Bhimbra, "Power Electronics", Khanna Publishers.

Reference Books:

1. Thomas E. Kissell, Industrial Electronics: Applications for Programmable Controllers, Instrumentation and Process Control, and Electrical Machines and Motor Controls, 3rd edition, 2003, Prentice Hall.
2. Chakrabarti & Rai, "Fundamentals of Power Electronics & Drives" Dhanpat Rai & Sons.
3. S.N.Singh, "A Text Book of Power Electronics" Dhanpat Rai & Sons.
4. G.K. Dubey, Power Semiconductor Controlled Drives, Prentice Hall inc. (1989).

Course Outcomes: At the end of this course students will be able to:

1. Describe the characteristics, operation of power switching devices and identify their ratings and applications.
2. Recognize the requirement of SCR Protection and describe the Functioning of SCR.
3. Analyze and design Power Converter based on SCR for various Industrial Applications.
4. Explain High Frequency Heating Systems, Timers, Relevant Sensors & Actuator and their application in industrial setting.
5. Explain and apply Data Communication, Telemetry & SCADA System in industrial applications.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-053	VLSI TECHNOLOGY	3L:0T:0P	3 Credits
----------------	------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Introduction To IC Technology: SSI, MSI, LSI, VLSI Integrated Circuits. Crystal Growth and Wafer Preparation: Electronic Grade Silicon, Czochralski Crystal Growth, Silicon Shaping, Processing Considerations. Wafer Cleaning Technology - Basic Concepts, Wet cleaning, Dry cleaning	8
II	Epitaxy: Vapor-Phase Epitaxy, Molecular Beam Epitaxy, Silicon on Insulators, Epitaxial Evaluation. Oxidation: Growth Kinetics, Thin Oxides, Oxidation Techniques and Systems, Oxides Properties.	8
III	Lithography: Optical Lithography, Electron beam lithography, Photo masks, Wet Chemical Etching. Dielectric and Polysilicon Film Deposition: Deposition Processes of Polysilicon, Silicon Dioxide, Silicon Nitride.	8
IV	Diffusion: Models of diffusion in solids, Fick's 1-Dimensional diffusion equation, Diffusion of Impurities in Silicon and Silicon Dioxide, Diffusion Equations, Diffusion Profiles, Diffusion Furnace, Solid, Liquid and Gaseous Sources, Ion-Implantation: Ion-Implantation Technique, Range Theory, Implantation Equipment.	8
V	Metallization: Metallization Application, Metallization Choices, Physical Vapor Deposition, Vacuum Deposition, Sputtering Apparatus. Packaging of VLSI devices: Package Types, Packaging Design Consideration, VLSI Assembly Technologies, Package Fabrication Technologies, CMOS fabrication steps.	8

Text Books:

1. S. M. Sze, "VLSI Technology", McGraw Hill Publication, 2nd Edition 2017
2. S.K. Gandhi, "VLSI Fabrication Principles", Willy-India Pvt. Ltd, 2008

Reference Books:

1. J. D. Plummer, M. D. Deal and Peter B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice and Modeling", Pearson Education Publication, 2009
2. Stephen A. Campbell, "Fabrication Engineering at the Micro and Nano scale", Oxford University Press, 2013

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

1. Interpret the basics of crystal growth, wafer preparation and wafer cleaning.
2. Evaluate the process of Epitaxy and oxidation.
3. Differentiate the lithography, etching and deposition process.
4. Analyze the process of diffusion and ion implantation
5. Express the basic process involved in metallization and packaging.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC 054	ADVANCED DIGITAL DESIGN USING VERILOG	3L:0T:0P	3 Credits
----------------	--	-----------------	------------------

Unit	Topic	Lectures
I	Introduction 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 State Machines, ASM Charts, Asynchronous Sequential Circuit Design, Races, Multi-level minimization and optimization.	8
IV	Factoring, Decomposition, BDD, Ordered BDD, LPDD, Fault Detection and Analysis in combinational and sequential systems, Path Sensitization method, Boolean Difference Method, 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. Tinker, "Engineering Digital Design", Academic Press.
2. Parag K. Lala, "Digital system Design Using PLDs", PHI India Ltd.
3. Stephen Brown and Zvonko Vranesiv, "Fundamental of Digital Logic with Verilog Design", Tata McGraw Hill.

Reference Books:

1. John Williams, "Digital VLSI Design with Verilog", Springer Publication..
2. Samuel C. Lee, "Digital Circuit and Logic Design", PHI India Ltd.
3. Alexander Miczo, "Digital Logic Testing and Simulation", Wiley Interscience.

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

1. Describe mixed logic circuits and their implementation.
2. Implement combinational circuits using mixed logic and Verilog.
3. Design sequential circuits using mixed logic and Verilog with mapping of Algorithm.
4. Understand faults and its elimination in sequential and combinational circuits.
5. Understand the working of programmable logic families.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-055	ELECTRONIC SWITCHING	3L:0T:0P	3 Credits
----------------	-----------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Evolution of switching systems: Introduction, Message switching, Circuits switching, Functions of a switching system, Register translator-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. Signaling: Introduction, Customer line signaling, Audio-frequency junctions and trunk circuits, FDM carrier systems, PCM signaling, Inter-register signalling, Common-channel signaling principles, CCITT signaling system no. 6 and 7, Digital customer line signaling.	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, Clos Networks).	8

Text Book:

1. Thiagarajan Viswanathan & Manav Bhatnagar, "Telecommunication Switching Systems and Networks", PHI, 2018
2. J.E. Flood, "Telecommunication Switching, Traffic and Networks", Pearson Education 2016.
3. John C. Bellamy, "Digital Telephony", John Wiley, 3rd Ed, 2006

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

1. Describe the fundamentals of circuit switching and distinguish complex telephone systems.
2. Differentiate the fundamentals of Space division switching and time division switching.
3. Design, develop and evaluate the telecom traffic to meet defined specifications and needs.
4. Identify the control of switching networks and signalling concepts.
5. Classify the engineering concepts of packet switching and routing which will help to design various switch architectures for future research work.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-056	ADVANCE SEMICONDUCTOR DEVICES	3L:0T:0P	3 Credits
----------------	--------------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Physics and Properties of Semiconductors: Introduction, Crystal Structure, Energy Bands and Energy Gap, Carrier Concentration at Thermal Equilibrium, Carrier-Transport Phenomena. Phonon, Optical, and Thermal Properties, Heterojunctions and Nanostructures, Basic Equations and Examples. <i>p-n</i> Junctions, Introduction, Depletion Region, Current-Voltage Characteristics, Junction Breakdown, Transient Behavior and Noise, Terminal Functions, Heterojunctions. Metal-Semiconductor Contacts, Metal-Insulator - Semiconductor Capacitors.	8
II	Bipolar Transistors: Static Characteristics, Microwave Characteristics, Related Device Structures, Heterojunction Bipolar Transistor. MOSFETs: Basic Device Characteristics, Nonuniform Doping and Buried-Channel Device, Device Scaling and Short-Channel Effects, MOSFET Structures, Circuit Applications, Nonvolatile Memory Devices, Single-Electron Transistor. JFETs, MESFETs, and MODFETs	8
III	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	Transferred-Electron and Real-Space-Transfer Devices Thyristors and Power Devices Photonic Devices and Sensors: Radioactive Transitions, Light-Emitting Diode (LED), Laser Physics, Laser Operating Characteristics, Specialty Lasers.	8
V	Photodetectors and Solar Cells: Photoconductor, Photodiodes, Avalanche Photodiode, Phototransistor, Charge-Coupled Device (CCD), Metal-semiconductor-Metal Photodetector, Quantum-Well Infrared Photodetector, Solar Cell. Sensors: Thermal Sensors, Mechanical Sensors, Magnetic Sensors, Chemical Sensors.	8

Text Book:

1. S. M. Sze, Kwok K. NG, "Physics of Semiconductor Devices", 3rd edition, Wiley Publication, 2015
2. Jacob Millman, Christos C. Halkias, Satyabrata Jit, Electronic Devices and Circuits. Publisher: TMH, 4th edition 2015.
3. Ben G. Streetman & S K Banerjee, Solid State Electronic Devices, Pearson 7th Edition, 2015
4. Pierret, Robert F., Semiconductor device fundamentals. 2nd Edition, Pearson Education India, 2015.

Course Outcomes: At the end of this course students will able to

1. Explain the behavior of BJT and MOSFET in DC biasing and as CE amplifier circuit.
2. Describe the Tunnel diode and IMPATT diode.
3. Explain the basics of Light-Emitting Diode (LED) and evaluate the performance of Photoconductor and photodiode.
4. Distinguish the performance of Photoconductor, photodiode, Phototransistor, Charge-Coupled Device
5. Analyze the functioning of Metal-Semiconductor-Metal Photodetector.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-057	ELECTRONIC MEASUREMENTS & INSTRUMENTATION	3L:0T:0P	3 CREDITS
----------------	--	-----------------	------------------

Unit	Topics	Lectures
I	Electrical Measurements: Measurement system, Characteristics of instruments, Methods of measurement, Errors in Measurement & Measurement standards, Measurement error combination. Review of indicating and integrating instruments: PMMC instrument, Galvanometer, DC ammeter, DC voltmeter, Series ohm meter.	8
II	Electronic Instruments: Transistor voltmeter circuits, AC electronic voltmeter, current measurement with electronic instruments, probes. Digital voltmeter systems: Digital multimeter, digital frequency meter Instrument calibration: Comparison method, digital multimeter as standard instrument, Calibration instrument.	8
III	Measuring Methods: Voltmeter and Ammeter methods, Wheatstone bridge, Measurement of low, medium and high resistances, Insulation resistance measurement, AC bridges for measurement of inductance and capacitance.	8
IV	Electronic Measurements: Electronic instruments: Wattmeter & Energy meter. Time, Frequency and phase angle measurements using CRO; Storage oscilloscope, Spectrum & Wave analyzer, Digital counter & Frequency meter, Q meter	8
V	Instrumentation: Transducers, classification & selection of transducers, strain gauges, Thermistors, Thermocouples, LVDT, Inductive & capacitive transducers, Piezoelectric and Hall-effect transducers, Measurement of motion, force, pressure, temperature, flow and liquid level.	8

Text Book:

1. A K Sawhney, "Electrical & Electronic Measurement & Instrument", Dhanpat Rai & Sons, India (2015).
2. BC Nakra & K. Chaudhary, "Instrumentation, Measurement and Analysis," TMH, 2nd Edition (2009).
3. WD Cooper, "Electronic Instrument & Measurement Technique", Prentice Hall International (2001).
4. E. O. Doebelin, "Measurements systems: Applications and Design", 6th Edition, Tata McGraw Hil 2017.

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

1. Classify the Instrumentation and Measurement system and various measurement errors.
2. Analyze and design voltmeter circuits, AC electronic voltmeter, digital frequency meter and current measurement with electronic instruments.
3. Evaluate various resistance and impedance measuring methods using Bridges and Q-meter.
4. Analyze fundamental operation of CRO and some special type of oscilloscopes like DSO, Sampling oscilloscope.
5. Demonstrate calibration method to calibrate various instruments and classify transducers like for force, pressure, motion, temperature measurement etc.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-058	OPTICAL COMMUNICATION	3L:0T:0P	3 Credits
----------------	------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	<p>Introduction to Optical Communication: Optical Spectral Band with Operating Windows, General Communication System, Optical Communication System with its advantages.</p> <p>Optical Fiber Waveguides: Ray Theory of Transmission with TIR, Acceptance Angle, Numerical Aperture and Skew Rays, Electromagnetic Mode Theory for Optical Propagation, Modes in a Planar Guide, Phase and Group Velocity, Phase Shift with Total Internal Reflection, Evanescent Field, Goos-Haenchen Shift, Cylindrical Fiber Modes, Mode Coupling, Step Index fibers Vs Graded Index fibers, Single Mode Fibers- Cut off wavelength, MFD & Spot Size.</p>	08
II	<p>Signal Loss in Optical Fibers: Attenuation, Material Absorption Losses (Intrinsic and Extrinsic absorption), types of Linear and Non-Linear Scattering Losses, Fiber Bending Losses, Kerr Effect.</p> <p>Dispersion: Introduction with its types: Chromatic / Intramodal Dispersion (Material and Waveguide Dispersion), Intermodal dispersion (for MSI and MGI fibers), Overall (Total) Fiber Dispersion in Multimode and Single Mode Fiber, Dispersion Modified Single Mode Fibers, Polarization & Fiber Birefringence.</p>	08
III	<p>Optical Sources: LEDs-Introduction to LEDs & Materials used for fabrication, LED Power and Efficiency, LED Structures, LED Characteristics, Modulation Bandwidth.</p> <p>Laser Diodes-Introduction, Optical Feedback & Laser Oscillations, Resonant Frequencies, Laser Modes, and Threshold Condition for Laser Oscillation, Laser Diode Rate Equations, Semiconductor injection Laser- Efficiency, Laser Single Mode operation, Reliability of LED & ILD.</p>	08
IV	<p>Power Launching in Fiber: Source to Fiber Power Launching and Coupling Techniques, Power Launching Vs Wavelength, Equilibrium Numerical Aperture.</p> <p>Photo Detectors: Introduction, Physical Principles of Photodiodes: The PIN Photo Detector, Avalanche Photodiodes, Temperature Effect on Avalanche Gain, Detector Response Time, Photo Detector Noise: Noise Sources, Signal to Noise Ratio, Comparison of Photo Detectors, Fundamental Receiver Operation with Digital Signal Transmission.</p>	08
V	<p>Digital Receiver Performance: Probability of Error / BER, Receiver Sensitivity & The Quantum Limit, Error Control Techniques, Eye Diagram Pattern Features, Coherent Detection: Homodyne Detection and Heterodyne Detection, Digital links: Point to Point Links, Power Penalties, Multichannel & Multiplexing Transmission Techniques, basic concept of Free Space Optics (FSO) based Communication System.</p>	08

Text Book:

1. John M. Senior, "Optical Fiber Communications", Pearson, 3rd Edition, 2010.
2. Gerd Keiser, "Optical Fiber Communications", McGraw Hill, 5th Edition, 2013.
3. Govind P. Agrawal, "Fiber Optic Communication Systems", John Wiley, 3rd Edition, 2004.

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

1. Define and explain the basic concepts and theory of optical communication.
2. Describe the signal losses with their computation and dispersion mechanism occurring inside the optical fiber cable.
3. Differentiate the optical sources used in optical communication with their comparative study.
4. Identify different optical components on receiver side; assemble them to solve real world problems related to optical communication systems.
5. Evaluate the performance of an optical receiver to get idea about power budget and ultimately be an engineer with adequate knowledge in optical domain.

KEC-551	INTEGRATED CIRCUITS LAB	0L:0T:2P	1 Credit
---------	-------------------------	----------	----------

SUGGESTIVE LIST OF EXPERIMENTS:

1. Design the following using Op-Amp: (*Through Virtual Lab Link 1*)
 - a) A unity gain amplifier.
 - b) An inverting amplifier with a gain of “A”.
 - c) A non-inverting amplifier with a gain of “A”
2. Study and design Log and antilog amplifiers.
3. Voltage to current and current to voltage convertors.
4. Second order filters using operational amplifier for: (*Through Virtual Lab Link 1*)
 - a) Low pass filter of cutoff frequency 1 KHz.
 - b) High pass filter of frequency 12 KHz.
5. Realization of Band pass filter with unit gain of pass band from 1 KHz to 12 KHz.
6. Study and design voltage comparator and zero crossing detectors.
7. Function generator using operational amplifier (sine, triangular & square wave).
8. Design and construct astable multivibrator using IC 555 and
 - a) Plot the output waveform
 - b) Measure the frequency of oscillation (*Through Virtual Lab Link 2*)
9. Design and construct a monostable multivibrator using IC 555 and
 - a) Plot the output waveform
 - b) Measure the time delay (*Through Virtual Lab Link 2*)
10. Implement Schmitt Trigger Circuit using IC 555. (*Through Virtual Lab Link 2*)
11. Implement voltage-controlled oscillator using IC566 and plot the waveform. (*Through Virtual Lab Link 2*)
12. Study and design ramp generator using IC 566.

Virtual Lab Link:

1. <http://vlabs.iitkgp.ernet.in/be/exp17/index.html>
2. <http://hecoep.vlabs.ac.in/Experiment8/Theory.html?domain=ElectronicsandCommunications&lab=Hybrid%20Electronics%20Lab>

Available on: <http://www.vlab.co.in/broad-area-electronics-and-communications>

Course Outcomes:

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

1. Design different non-linear applications of operational amplifiers such as log, antilog amplifiers and voltage comparators.
2. Explain and design different linear applications of operational amplifiers such as filters.
3. Demonstrate the function of waveforms generator using op-Amp.
4. Construct multivibrator and oscillator circuits using IC555 and IC566 and perform measurements of frequency and time.
5. Design and practically demonstrate the applications based on IC555 and IC566.

KEC-552	MICROPROCESSOR & MICROCONTROLLER LAB	0L:0T:2P	1 Credit
---------	---	----------	----------

SUGGESTIVE LIST OF EXPERIMENTS:

1. Write a program using 8085 Microprocessor for Decimal, Hexadecimal addition and subtraction of two Numbers. *(Through Virtual Lab Link)*
2. Write a program using 8085 Microprocessor for addition and subtraction of two BCD numbers. *(Through Virtual Lab Link)*
3. To perform multiplication and division of two 8 bit numbers using 8085. *(Through Virtual Lab Link)*
4. To find the largest and smallest number in an array of data using 8085 instruction set.
5. To write a program using 8086 to arrange an array of data in ascending and descending order. *(Through Virtual Lab Link)*
6. To convert given Hexadecimal number into its equivalent ASCII number and vice versa using 8086 instruction set.
7. To convert given Hexadecimal number into its equivalent BCD number and vice versa using 8086 instruction set.
8. To interface 8253 programmable interval timer and verify the operation of 8253 in six different modes.
9. To write a program to initiate 8251 and to check the transmission and reception of character.
10. Serial communication between two 8085 through RS-232 C port.
11. Write a program of Flashing LED connected to port 1 of the 8051 Micro Controller
12. Write a program to generate 10 kHz square wave using 8051.
13. Write a program to show the use of INT0 and INT1 of 8051.
14. Write a program for temperature & to display on intelligent LCD display.

Virtual Lab Link: http://vlabs.iitb.ac.in/vlabs-dev/labs_local/microprocessor/labs/explist.php

Available on: <http://www.vlab.co.in/broad-area-electronics-and-communications>

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

1. Use techniques, skills, modern engineering tools, instrumentation and software/hardware appropriately to list and demonstrate arithmetic and logical operations on 8 bit data using microprocessor 8085.
2. Examine 8085 & 8086 microprocessor and its interfacing with peripheral devices.
3. State various conversion techniques using 8085 & 8086 and generate waveforms using 8085.
4. Implement programming concept of 8051 Microcontroller.
5. Design concepts to Interface peripheral devices with Microcontroller so as to design Microcontroller based projects.

KEC-553	DIGITAL SIGNAL PROCESSING LAB	0L:0T:2P	1 Credit
---------	-------------------------------	----------	----------

SUGGESTIVE LIST OF EXPERIMENTS:

1. Introduction to MATLAB and or Open Source Software, Scilab (Using Spoken Tutorial MOOCs).
2. Write a Program for the generation of basic signals such as unit impulse, unit step, ramp, exponential, sinusoidal and cosine.
3. Implement IIR Butterworth analog Low Pass for a 4 KHz cut off frequency.
4. Verify Blackman and Hamming windowing techniques.
5. Evaluate 4-point DFT of and IDFT of $x(n) = 1, 0 \leq n \leq 3; 0$ elsewhere.
6. Verify Linear convolution of two sequences using FFT
7. Verify Circular Convolution of two sequences using FFT.
8. To verify FFT as sample interpolator.
9. To implement Tone Generation.
10. To implement floating point arithmetic.
11. To study about DSP Processors and architecture of TMS320C6713 DSP processor.
12. **VIRTUAL Lab by NME-ICT available at: (*Through Virtual Lab*)**
 - 12.1 Study of Discrete Fourier Transform (DFT) and its inverse.
 - 12.2 Study of FIR filter design using window method: Lowpass and highpass filter.
 - 12.3 Study of FIR filter design using window method: Bandpass and Bandstop filter.
 - 12.4 Study of Infinite Impulse Response (IIR) filter.

Virtual Lab Link: [http://vlabs.iitkgp.ernet.in/dsp/index.html#
http://vlabs.iitkgp.ernet.in/dsp/](http://vlabs.iitkgp.ernet.in/dsp/index.html#http://vlabs.iitkgp.ernet.in/dsp/)

Available on: <http://www.vlab.co.in/broad-area-electronics-and-communications>

Spoken Tutorial (MOOCs):

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

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

1. Create and visualize various discrete/digital signals using MATLAB/Scilab.
2. Implement and test the basic operations of Signal processing.
3. Examine and analyse the spectral parameters of window functions.
4. Design IIR and FIR filters for band pass, band stop, low pass and high pass filters.
5. Design the signal processing algorithms using MATLAB/Scilab.

B.Tech 3rd Year
VI Semester
Syllabus

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-601	DIGITAL COMMUNICATION	3L:1T:0P	4 Credits
---------	-----------------------	----------	-----------

Unit	Topics	Lectures
I	Random Variables: Concept of Probability, Random variables, Statistical averages, Random process, Power Spectral Density & Autocorrelation Function of Random Processes, Gaussian Random Process.	8
II	Digital Communication Basics: Introduction to Digital communication systems, PSD of Line Coding schemes, Pulse shaping, Scrambling, Eye diagram, Gram-Schmidt orthogonalization scheme.	8
III	Digital Modulation: Modulation and Demodulation of Digital modulation schemes-ASK, FSK, PSK, DPSK, QPSK. Constellation diagram, Introduction to M-ary communication.	8
IV	Digital Receiver: Optimum threshold detection, Concept of Matched Filters, BER analysis of BASK, BFSK, BPSK, Introduction of Spread spectrum communication (DS-SS, FH-SS).	8
V	Information Theory: Measure of information-information, entropy, mutual information, mutual entropy, Source encoding (Shannon-Fano, Huffman), Shannon's channel capacity theorem, Introduction to error correction and detection, Linear block codes, Cyclic codes (systematic, non-systematic), Convolution coding and decoding.	8

Text Books:

1. B.P. Lathi, "Modern Digital and Analog communication Systems", 4th Edition, Oxford University Press.
2. John G. Proakis, "Digital Communications", 5th Edition, TMH.
3. H. Taub, D L Schilling, Gautam Saha, "Principles of Communication", 4th Edition, TMH.
4. Singh & Sapray, Communication Systems, 3th Edition, TMH.

Reference Books:

1. Simon Haykin, "Communication Systems", 5th Edition, Wiley India.
2. (Schaum's Outline Series) H P HSU & D Mitra, "Analog and Digital Communications", TMH, 3rd Edition.

Course Outcomes: At the end of this course students will demonstrate the ability:

1. To formulate basic statistics involved in communication theory.
2. To demonstrate the concepts involved in digital communication.
3. To explain the concepts of digital modulation schemes.
4. To analyze the performance of digital communication systems.
5. To apply the concept of information theory in digital systems.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-602	Control System	3L:1T:0P	4 Credits
---------	----------------	----------	-----------

Unit	Topics	Lectures
I	Introduction to Control Systems: 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, free body diagram, analogous Systems, sensors and encoders in control systems, modeling of armature controlled and field controlled DC servomotor.	8
II	State-Variable Analysis: Introduction, 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, 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, unit step response and time-domain specifications, time response of a first order system, transient response of a prototype second order system, Steady-State error, Static and dynamic error coefficients, error analysis for different types of systems.	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: Resonant peak and Resonant frequency, 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, stability analysis with the Bode plot, relative stability: gain margin and phase margin.	8

Text Book:

1. I. J. Nagrath & M. Gopal, "Control System Engineering", 6th Ed. New Age International Publishers, 2018
2. B.C. Kuo & Farid Golnaraghi, "Automatic Control Systems", 9th Edition, John Wiley India, 2008

Reference Books:

1. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Control Systems", 3rd Edition, TMH, Special Indian Edition, 2010.
2. A. Anand Kumar, "Control Systems", Second Edition, PHI Learning private limited, 2014.
3. William A. Wolovich, "Automatic Control Systems", Oxford University Press, 2011.

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

1. Describe the basics of control systems along with different types of feedback and its effect. Additionally they will also be able to explain the techniques such as block diagrams reduction, signal flow graph and modelling of various physical systems along with modelling of DC servomotor.
2. Explain the concept of state variables for the representation of LTI system.
3. Interpret the time domain response analysis for various types of inputs along with the time domain specifications.
4. Distinguish the concepts of absolute and relative stability for continuous data systems along with different methods.
5. Interpret the concept of frequency domain response analysis and their specifications.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-603	Antenna & Wave Propagation	3L:1T:0P	4 Credits
----------------	---------------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Coordinate Systems and Transformation: Cartesian, Cylindrical, Spherical transformation. Vector calculus: Differential length, area and volume, line, surface and volume integrals, Del operator, Gradient, Divergence of a vector, Divergence theorem, Curl of a vector, Stokes's theorem, Laplacian of a scalar.	6
II	Electrostatic fields and Magnetostatic fields: Electric field intensity, Electric field due to charge distribution, Electric flux density, Gauss's Law- Maxwell's equation, Continuity equation and relaxation time, boundary conditions, Magneto-static fields, Ampere's circuit law, Maxwell's equation, magnetic scalar and vector potential, Magnetic boundary conditions, Maxwell's equation in final form.	10
III	Antenna fundamental and definitions: 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.	8
IV	Antenna Design: Electric dipoles, The short electric dipole, The fields of a short dipole, Radiation resistance of short electric dipole, Thin linear antenna, Radiation resistance of $\lambda/2$ antenna, Array of two driven $\lambda/2$ elements: Broadside case and end-fire case, Horizontal antennas above a plane ground, Vertical antennas above a plane ground, Yagi-Uda antenna design, Longwire antennas, Folded dipole antennas.	8
V	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.	8

Text Books:

1. MNO Sadiku, "Elements of Electromagnetic", 7th Ed, Oxford University Press, 2018.
2. John D Kraus, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 5th Edition, Tata McGraw Hill, 2017.
3. Das, Antennas and Wave Propagation, TMH 1st Edition.
4. C. A. Balanis, "Antenna Theory Analysis and Design", John Wiley, 2016.
5. WH Hayt and JA Buck, "Engineering Electromagnetic", 7th Edition TMH, 2013.
6. (Schaums Outlines Series) Joseph J. Distefano III, Allen R. Stubberud, Ivan J. Williams, "Engineering Electromagnetic", 3rd Edition, TMH, Special Indian Edition, 2010.

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

1. Identify different coordinate systems and their applications in electromagnetic field theory to establish a relation between any two systems using the vector calculus.
2. Explain the concept of static electric field, current and properties of conductors.
3. Express the basic concepts of ground, space, sky wave propagation mechanism.
4. Demonstrate the knowledge of antenna fundamentals and radiation mechanism of the antenna.
5. Analyze and design different types of basic antennas.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-061	MICROCONTROLLER & EMBEDDED SYSTEMS DESIGN	3L:0T:0P	3 Credits
----------------	--	-----------------	------------------

Unit	Topics	Lectures
I	<p>Advanced concepts in 8051 architecture: Review of 8051 architecture, concept of synchronous serial communication, SPI and I2C communication protocols, study of SPI port on 89LP 51RD2, study of SAR ADC/DAC MCP3304 / MCP 33, interfacing concepts for SPI based ADC/DAC, study of watchdog timer, study of PCA timer in different modes like capture mode, PWM generation mode, High speed output toggle mode Embedded 'C' programming for the above peripherals</p> <p>Introduction, AVR Family architecture, Register File, The ALU. Memory access and Instruction execution. I/O memory. EEPROM. I/O ports. Timers. Interrupt Structure</p>	8
II	<p>MSP430x5x Microcontroller: 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.</p>	8
III	<p>Introduction to Embedded Systems: Describe what an embedded system is and its main components, Outline the different options available for building embedded systems, Explain the benefits, functions, and attributes of embedded systems, Examine the constraints specific to embedded systems and their impact</p> <p>The Arm Cortex-M4 Processor Architecture: Outline the different Arm processor families, Differentiate between an Arm processor and an Arm architecture, Outline the main features of Arm Cortex-M4 processors, Distinguish the different blocks and registers in an Arm Cortex-M4 processor.</p>	8
IV	<p>Introduction to the Internet of Things: Describe the concepts of IoT and understand the key elements of an IoT device, Outline the evolution of IoT, Describe the main technologies that enable IoT, Identify the key challenges facing IoT systems, Evaluate the opportunities and risks that emerge with IoT adoption</p> <p>Hardware Platforms for IoT: Identify the concepts of hardware platform and the factors influencing its design, Differentiate between various types of memory, Explain the principles of sensors and the role of I/O, Describe analog-to-digital and digital-to-analog conversion techniques, Identify the different techniques that can be used to save energy</p>	8
V	<p>Introduction to the Mbed Platform and CMSIS: Describe the Mbed platform and its functionalities, Explain the different components of the Mbed OS, Identify the different Mbed development tools that are available, Identify the features offered by the Mbed SDK and HDK, Outline the Cortex Microcontroller Software Interface Standard (CMSIS) tool and its benefits.</p> <p>IoT Connectivity: Identify the concept of Bluetooth technology, Identify key features of the Bluetooth and Bluetooth Low Energy protocols, Explain how a Bluetooth connection is secured, Outline the new features that are introduced in the Bluetooth 5 specification, Explain the architecture and protocol stack used in ZigBee.</p>	8

Text Books:

1. Mazidi Ali Muhammad, Mazidi Gillispie Janice, and Mc Kinlay Rolin D "The 8051 Microcontroller and Embedded Systems using Assembly and C", Pearson Publication, 2006

2. John H Davies, “MSP430 Microcontroller Basics” Newnes Publication,2008.
3. Embedded Systems Fundamentals on Arm Cortex-M based Microcontrollers: A Practical Approach by Alexander G. Dean <https://www.arm.com/resources/education/textbooks/efficient-embedded-systems>

Reference Books:

1. TI MSP430x5xx and MSP430x6xx Family User's Guide , Revised 2018.
2. The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors, Third Edition by Joseph Yiu
3. [Cortex-A Series Programmer's Guide](http://infocenter.arm.com/help/topic/com.arm.doc.den0013d/index.html) for ARMv7-A by Arm from <http://infocenter.arm.com/help/topic/com.arm.doc.den0013d/index.html>
4. White Paper: Cortex-M for Beginners - An overview of the Arm Cortex-M processor family and comparison:<https://community.arm.com/developer/ip-products/processors/b/processors-ip-blog/posts/white-paper-cortex-m-for-beginners-an-overview-of-the-arm-cortex-m-processor-family-and-comparison>.

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

1. Explain the advance concept of 8051 architectures and AVR family architecture and compare them for different applications.
2. To demonstrate the basics of MSP430x5x Microcontroller
3. To execute the I/O interfacing and peripheral devices associated with Microcontroller SoC (system on chip).
4. Explain the advance concept Arm Cortex-M4 Processor Architecture.
5. Demonstrate the ability to do Demonstrate the basics of Embedded Systems, IoT and its application and design IoT based projects on Arm based development boards

ELECTRONICS AND COMMUNICATION ENGINEERING

7.

KEC-062	SATELLITE COMMUNICATION	3L:0T:0P	3 Credits
---------	-------------------------	----------	-----------

Unit	Topics	Lectures
I	Introduction to Satellite Communication: History, Overview of Satellite Communication, Types of Satellite, Types of Orbit, Satellite services, Advantages & Applications of Satellite communication, Satellite Life phases, Space Debris, Introduction to Geo-synchronous and Geo-stationary satellites.	8
II	Orbital Mechanics: Orbital Mechanics, Kepler's Three laws of Planetary Motion, Developing the Equations of the orbit, Look Angle Determination, Earth Stations, Orbital Perturbations, Orbital effects in Communication system performance.	8
III	Satellite Sub-systems: Seven segments of Satellite communication, Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system. 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.	8
IV	Introduction to Various Satellite Systems: VSAT, 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
V	Launchers & Advanced Technologies: Mechanism of Satellite launching, Launch Vehicles, Advanced launching tech like Space X, Intelligent Testing, Control and Decision making for Space, Inter Satellite Link. Indian Satellite Systems: History and Overview of Indian Satellite System, Achievements, GSLV, PSLV, Advanced Technology Vehicle.	8

Text Books:

1. B.Pratt, A.Bostian, "Satellite Communications", Wiley India, 2nd Edition, 2006.
2. D. Roddy, "Satellite Communications", TMH, 4th Edition, 2001.
3. Digital Satellite Communications/ Tri T. Ha./ McGraw-Hill, 2nd Edition
4. D.C. Agrawal, Satellite communication, Khanna Publishers; 7th Edition.

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

1. Define and list the benefits of satellite communication.
2. Demonstrate orbital mechanics principles of satellite communication systems and solve problems related to it.
3. Describe a satellite link and identify ways to improve the link performance.
4. Classify new technologies of satellite communication systems as per given specifications.
5. Examine advanced technologies of satellite launching and describe the Indian satellite system.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-063	DATA COMMUNICATION NETWORKS	3L:0T:0P	3 Credits
----------------	------------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Introduction to Networks & Data Communications: Goals and Applications of Networks ,The Internet, Protocols & Standards, Layered Tasks, 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, Noiseless Channel and Noisy Channel Protocol, HDLC, Point-to-Point Protocol	8
III	Multiple Access: RANDOH, CDMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization Wired LANs: IEEE Standards, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, Wireless LAN IEEE 802.11, Bluetooth IEEE 802.16.	8
IV	Network Layer: Design Issues. Routing Algorithms. Congestion control Algorithms. Internetworking –TCP/IP, IP Packet, IPv4 and IPv6 Protocols, IPV4 Addresses, Connecting Devices, Virtual LAN IPV6 Addresses.	8
V	Transport Layer Protocol: UDP and TCP, ATM, Cryptography, Network Security, Session Layer-Design issues. Application Layer: File Transfer, Electronic mail, HTTP, WWW, SMTP, Cryptography, Network Security.	8

Text Books:

1. B. A. Forouzan, “Data Communications and Networking”, 5th Edition, TMH, 2017.

Reference Books:

1. S. Tanenbaum, “Computer Networks”, 4th Edition, Pearson, 2013.
2. W. Stallings, “Data and Computer Communication”, 8th Edition, Pearson, 2007.

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

1. Identify the issues and challenges in the architecture of a network.
2. Analyze the services and features of various protocol layers in data layer.
3. Demonstrate the knowledge of multiple access to design a access technique for a particular application.
4. Realize protocols at different layers of a network hierarchy.
5. Recognize security issues in a network and various application of application layer.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-064	ANALOG SIGNAL PROCESSING	3L : 0T : 0P	3 Credits
---------	--------------------------	--------------	-----------

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.	8
II	Ideal low-pass filter, Butterworth 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.	8
IV	The General Impedance Converter (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	8

Text Book:

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

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

1. Describe and apply fundamentals of signal processing in analog domain and its associated concepts like OTA and current conveyor.
2. Introduction of filter and its designing parameters
3. Solve problems and design higher order filters like Butterworth and Chebyshev.
4. Understand and explain the reasons for delay in filter designing and its procedure to equalize.
5. Understand the principles of the inductor simulation like general impedance converter (GIC), optimal design of the GIC, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique which are used for placing equivalent inductor on integrated circuits.

ELECTRONICS AND COMMUNICATION ENGINEERING

KEC-065	RANDOM VARIABLES & STOCHASTIC PROCESS	3L:0T:0P	3 Credits
----------------	--	-----------------	------------------

Unit	Topics	Lectures
I	Probability: Introduction to set theory, experiments and sample spaces, joint probability, conditional probability, concept of total Probability, Bayes' Theorem, and independent events, Bernoulli's trials, combined experiments.	8
II	Random Variables: Introduction, types of random variables, cumulative distribution function and probability density functions, Standard distributions: Gaussian, exponential, Rayleigh, uniform, Bernoulli, binomial, Poisson, discrete uniform and conditional distributions. Functions of one random variable: distribution, mean, variance, moments and characteristics functions.	8
III	Multiple Random Variables: Joint distributions, joint density function and properties, marginal distribution and density functions, conditional distribution and density Functions, statistical independence, functions of two random variables, joint moments, Multiple random variables: multiple functions of multiple random variables, jointly Gaussian random variables, sums of random variable, Central limit theorem.	8
IV	Stochastic Processes: Definitions, Random process concept, Statistics of stochastic processes: Mean, Autocorrelation, Covariance Functions and its properties, Strict and Wide sense stationary, random processes, Time Averages and Ergodicity, Mean-Ergodic Processes.	8
V	Stochastic Processes in Frequency Domain: Power spectrum of stochastic processes, Properties of power spectral density, Relationship between Power Spectrum and Autocorrelation Function, the Cross-Power Density Spectrum and Properties, Relationship between Cross-Power Spectrum and Cross-Correlation Function, Transmission over LTI systems, Gaussian and White processes.	8

Text Books:

1. Probability, Random Variables And Stochastic Processes, Papoulis, TMH (2002)
2. Stochastic Processes, 2ed, Ross, Wiley.(1996)

Reference Books:

1. Devore – Probability and statistics for engineering and sciences, Cengage learning 2011
2. Mendenhall – Introduction to probability and statistics, Cengage learning 2012
3. Probability, Random Variables And Random Signal Principles, Peebles, TMH 2002
4. Probability Theory and Stochastic Processes for Engineers, Bhat, Pearson 2011
5. Probability and Random Processes with Application to Signal Processing, 3/e, Stark, Pearson 2002
6. Random Variables & Stochastic Processes, Gaur and Srivastava, Genius publications 2003
7. Random Processes: Filtering, Estimation and Detection, Ludeman, Wiley 2002
8. An Introduction to Probability Theory & Its App., Feller, Wiley 1969

Course Outcomes:

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

1. Students will be able to explain the basic learning of Probability.
2. Students will be able to demonstrate the concept of Random Variables.
3. Students will be able to analyze Multiple Random Variables.
4. Students will be able to interpret the basics of Stochastic Processes.
5. Students will be able to express Stochastic Processes in Frequency domain.

KEC-651	DIGITAL COMMUNICATION LAB	0L:0T:2P	1 Credit
---------	---------------------------	----------	----------

SUGGESTIVE LIST OF EXPERIMENTS:

Part A

1. To study Eye diagram patterns of various digital pulses.
2. To study the inter symbol interference.
3. To study generation of Unipolar RZ & NRZ Line Coding.
4. To study generation of Polar RZ & NRZ Line Coding.
5. To study generation of Bipolar RZ & NRZ Line Coding.
6. Implementation and analysis of BASK modulation and demodulation
7. Implementation and analysis of BFSK modulation and demodulation
8. Implementation and analysis of BPSK modulation and demodulation. (*Through Virtual Lab*)
9. Implementation and analysis of QPSK modulation and demodulation. (*Through Virtual Lab*)
10. To simulate M-ary Phase shift keying technique using MATLAB.
11. To study generation and detection of DPSK using MATLAB.
12. Implementation and analysis of Delta modulation and demodulation.
13. Implementation and analysis of DSSS Modulation, Demodulation & BER measurement.
14. Implementation and analysis of FHSS Modulation, Demodulation & BER measurement.
15. To study encoding and decoding of Linear Block Codes
16. To study the working of Convolution encoder.

Part B

1. To study simple dipole $\lambda/2$ antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
2. To study folded dipole antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
3. To study $\lambda/2$ phase array end-fire antenna and to calculate beam-width, front / back ratio, and gain of the antenna.
4. To study broadside array antenna and to calculate beam-width, front / back ratio, and gain of the antenna.

Virtual Lab Link: <https://vlab.amrita.edu/?sub=1&brch=201>

Course Outcomes: At the end of this course students will demonstrate the ability:

1. To formulate basic concepts of pulse shaping in digital communication.
2. To identify different line coding techniques and demonstrate the concepts.
3. To design equipments related to digital modulation and demodulation schemes.
4. To analyze the performance of various digital communication systems and evaluate the key parameters.
5. To conceptualize error detection & correction using different coding schemes in digital communication.

SUGGESTIVE LIST OF EXPERIMENTS:

1. Introduction to MATLAB Control System Toolbox.
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. Create the state space model of a linear continuous system.
6. Determine the State Space representations of the given transfer function.
7. Determine the time response of the given system subjected to any arbitrary input.
8. Plot unit step response of given transfer function and find delay time, rise time, peak time, peak overshoot and settling time.
9. Determine the steady state errors of a given transfer function.
10. Plot root locus of given transfer function, locate closed loop poles for different values of k.
11. Plot bode plot of given transfer function. Also determine gain and phase margins.
12. Plot Nyquist plot for given transfer function. Also determine the relative stability by measuring gain and phase margin.

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

1. Classify different tools in MATLAB along with the basic matrix operations used in MATLAB.
2. Evaluate the poles and zeros on s-plane along with transfer function of a given system.
3. Construct state space model of a linear continuous system.
4. Evaluate the various specifications of time domain response of a given system.
5. Appraise the steady state error of a given transfer function.
6. Examine the relative stability of a given transfer function using various methods such as root locus, Bode plot and Nyquist plot.

SUGGESTIVE LIST OF EXPERIMENTS:

1. Measurement of phase difference and frequency using CRO (Lissajous Figure)
2. Study of L.C.R. Bridge and determination of the value of the given components.
3. Characteristics of Thermocouples and RTD.
4. Study of the following transducer (i) PT-100 Transducer (ii) J-Type Transducer (iii) K-Type Transducer (iv) Pressure Transducer
5. Characteristics of LDR, Photo Diode, and Phototransistor:
 - (i) Variable Illumination.
 - (ii) Linear Displacement
6. Characteristics of LVDT.
7. Study of the transistor tester and determination of the parameters of the given transistors
8. Experiment using PLC Trainer Kits

Through Virtual Lab:

9. Measurement of low resistance Kelvin's double bridge.
10. To measure unknown capacitance of small capacitors by using Schering's bridge.
11. To measure unknown Inductance using Hay's bridge.
12. Measurement of capacitance by De Sauty Bridge.

Virtual Lab Link: <http://vlabs.iitkgp.ernet.in/asnm/#>

Available on: <http://www.vlab.co.in/broad-area-electronics-and-communications>

Course Outcomes:

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

1. Measure the unknown resistance, capacitance and inductance using LCR Bridge, Kelvin double bridge, Schering bridge, Hay's bridge, De sauty bridge.
2. Practically demonstrate the different types of transducers like J-type, K-type, PT-100 and RTD.
3. Interpret frequency and phase difference from Lissajous figure.
4. Interpret hybrid parameters of transistor and demonstrate different transducer like LDR and LVDT.
5. Demonstrate Experiment using PLC Trainer Kits

SUGGESTIVE LIST OF EXPERIMENTS:

Part A

PSpice Experiments:

1. (a) Transient Analysis of BJT inverter using step input.
(b) DC Analysis (VTC) of BJT inverter
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.
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 NAND Gate using CMOS inverter.
5. Transient Analysis of NOR Gate inverter and implementation of XOR gate using NOR gate
6. To design and perform transient analysis of D latch using CMOS inverter.
7. To design and perform the transient analysis of SR latch circuit using CMOS inverter.
8. To design and perform the transient analysis of CMOS transmission gate.
9. Analysis of frequency response of Common Source amplifiers.
10. Analysis of frequency response of Source Follower amplifiers

Part B :

HDL (using VHDL program module & verilog Module)

VHDL PROGRAMS

1. Design and Simulation of Full Adder using VHDL program module
2. Design and Simulation of 4x1 MUX using VHDL **program module**
3. Design and Simulation of BCD to Excess-3 code using VHDL **program module**
4. Design and Simulation of 3 to 8 decoder using VHDL **program module**
5. Design and Simulation of JK Flip-flop using VHDL **program module**
6. Design and Simulation of CMOS Inverter using **verilog Module**

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

1. Design and analyze the performance of different type of inverters.
2. Design and analyze the performance of the basic logic gates using CMOS inverter circuit.
3. Design and analyze the performance of the memory based digital circuits using CMOS inverter circuit.
4. Analyze the performance of the different configuration of MOS amplifier circuits.

KEC-653C	MICROCONTROLLERS FOR EMBEDDED SYSTEM LAB	0L:0T:2P	1 Credit
----------	--	----------	----------

SUGGESTIVE LIST OF EXPERIMENTS:

Part A

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.

Part B: Based on MSP 430

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

Part B: Based on ARM Process:

1. To develop and verify the interfacing ADC and DAC with LPC 2148 Arm Micro Controller.
2. Interfacing of LED and PWM with Micro Controller. (ARM-) using embedded C program.
3. Interfacing of serial port with Arm processor using embedded C-program.
4. Interfacing of key board and LCD with Arm processor using embedded C-Program.
5. To develop and verify Embedded C program mailbox using ARM.
6. To implement zigbee protocol with ARM program.
7. Implement the lighting and winking LEDs of the ARM I/O port via programming.
8. ARM programming in C language using KEIL IDE.
9. Demonstrate the TIMING concept of real time application using RTOS on ARM microcontroller kit.
10. Demonstrate the Multi-Tasking concept of real time application using RTOS on ARM microcontroller.
11. Demonstrate the RS 232 serial communication using RTOS on ARM microcontroller kit.
12. ISR (Interrupt Service Routine) programming in ARM based system with I/O port.

Part C: Virtual Lab Platform

<http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/labs/index.php>

<https://www.soc.uoguelph.ca/webfiles/engg4420/EmbeddedSystemsAndLabsForARM-V1.1.pdf>

https://profile.iiita.ac.in/bibhas.ghoshal/IEMB_2018/Lectures/ES_basics.pdf

<https://nptel.ac.in/courses/108/102/108102045/>

Practical Outcome The Student able to:

1. To understand the basis work of microcontroller and learn the working.
2. To understand the building blocks of embedded system.
3. To learn the concept of interfacing with different devices.
4. To relate the concept of memory map and memory interface.
5. To discover the characteristics of real time system.
6. To validate the process using know input-output parameters.
7. Demonstrate knowledge of programs environment and executing variety of programs.

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. Susan 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

K₁ – Remember, K₂ – Understand, K₃ – Apply, K₄ – Analyze, K₅ – Evaluate, K₆ – 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.

B.Tech. (Electronics & Communication Engg.)

Semester III

Sr. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
	KOE031-38/ KAS302	Engg. Science Course /Maths IV	3	1	0	30	20	50		100		150	4
1.	KAS301/ KVE301	Technical Communication /Universal Human values	2	1	0	30	20	50		100		150	3
			3	0	0								
2.	KEC301	Electronic Devices	3	1	0	30	20	50		100		150	4
3.	KEC302	Digital System Design	3	1	0	30	20	50		100		150	4
4.	KEC303	Network Analysis and Synthesis	3	0	0	30	20	50		100		150	3
6.	KEC351	Electronics Devices Lab	0	0	2				25		25	50	1
7.	KEC352	Digital System Design Lab	0	0	2				25		25	50	1
8.	KEC353	Network Analysis and Synthesis lab	0	0	2				25		25	50	1
9.	KEC354	Mini Project or Internship Assessment	0	0	2			50				50	1
10.	KNC301 /KNC302	Computer System Security /Python Programming	2	0	0	15	10	25		50			0
11.		MOOCs (Essential for Hons. Degree)											
		TOTAL										950	22

*The Mini Project or internship (3-4 weeks) conducted during summer break after II semester and will be assessed during III semester.

Semester IV

Sr. No.	Course Code	Course Title	Periods			Evaluation Scheme				End Semester		Total	Credits
			L	T	P	CT	TA	Total	PS	TE	PE		
1.	KAS402/ KOE041-48	Maths-IV / Engg. Science Course	3	1	0	30	20	50		100		150	4
2.	KVE401/ KAS401	Universal Human Values/ Technical Communication	3	0	0	30	20	50		100		150	3
			2	1	0								
3.	KEC401	Communication Engineering	3	0	0	30	20	50		100		150	3
4.	KEC402	Analog Circuits	3	1	0	30	20	50		100		150	4
5.	KEC403	Signal System	3	1	0	30	20	50		100		150	4
6.	KEC451	Communication Engineering Lab	0	0	2				25		25	50	1
7.	KEC452	Analog Circuits Lab	0	0	2				25		25	50	1
8.	KEC453	Signal System Lab	0	0	2				25		25	50	1
9.	KNC402/ KNC401	Python Programming/ Computer System Security	2	0	0	15	10	25		50			0
10.		MOOCs (Essential for Hons. Degree)											
		TOTAL										900	21

KEC301	Electronics Devices	3L:1T:0P	4 Credits
---------------	----------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Introduction to semiconductor physics: Review of quantum mechanics, electrons in periodic lattices, E-k diagrams.	8
II	Energy bands in intrinsic and extrinsic silicon, carrier transport, diffusion current, drift current, mobility and resistivity, sheet resistance, design of resistors.	8
III	Generation and recombination of carriers, Poisson and continuity equation P-N junction characteristics, I-V characteristics, and small signal switching models.	8
IV	Avalanche breakdown, Zener diode, Schottky diode, Bipolar Junction Transistor, I-V characteristics, Ebers-Moll model.	8
V	MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell.	8

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, "Solid State Electronic Devices," 7th edition, Pearson, 2014.
2. D. Neamen , D. Biswas, "Semiconductor Physics and Devices," McGraw-Hill Education.
3. S. M. Sze and K. N. Kwok, "Physics of Semiconductor Devices," 3rd edition, John Wiley & Sons, 2006.
4. C.T. Sah, "Fundamentals of Solid State Electronics," World Scientific Publishing Co. Inc, 1991.
5. Y. Tsvividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford univ. press, 2011.
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 principles of semiconductor Physics.
 2. Understand and utilize the mathematical models of semiconductor junctions.
 3. Understand carrier transport in semiconductors and design resistors.
 4. Utilize the mathematical models of MOS transistors for circuits and systems.
 5. Analyse and find application of special purpose diodes.
-

KEC302	Digital System Design	3L:1T:0P	4 Credits
---------------	------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Logic simplification and combinational logic design: Binary codes, code conversion, review of Boolean algebra and Demorgans theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, tabulation method.	8
II	MSI devices like comparators, multiplexers, encoder, decoder, driver & multiplexed display, half and full adders, subtractors, serial and parallel adders, BCD adder, barrel shifter and ALU.	8
III	Sequential logic design: Building blocks like S-R, JK and Master-Slave JK FF, edge triggered FF, state diagram, state reduction, design of sequential circuits, ripple and synchronous counters, shift registers, finite state machines, design of synchronous FSM, algorithmic state machines charts. Designing synchronous circuits like pulse train generator, pseudo random binary sequence generator, clock generation.	8
IV	Logic families and semiconductor memories: TTL NAND gate, specifications, noise margin, propagation delay, fan-in, fan-out, tristate TTL, ECL, CMOS families and their interfacing, memory elements, concept of programmable logic devices like FPGA, logic implementation using programmable devices.	8
V	Digital-to-Analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. analog-to-digital converters (ADC): single slope, dual slope, successive approximation, flash etc. switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.	8

Text/Reference Books:

1. R.P. Jain, "Modern Digital Electronics," Tata McGraw Hill, 4th edition, 2009.
2. A. Anand Kumar, "Fundamental of Digital Circuits," PHI 4th edition, 2018.
3. W.H. Gothmann, "Digital Electronics- An Introduction to Theory and Practice," PHI, 2nd edition, 2006.
4. D.V. Hall, "Digital Circuits and Systems," Tata McGraw Hill, 1989.
5. A. K. Singh, "Foundation of Digital Electronics & Logic Design," New Age Int. Publishers.
6. Subrata Ghosal, "Digital Electronics," Cengage publication, 2nd edition, 2018

Course outcomes:

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

1. Design and analyze combinational logic circuits.
 2. Design and analyze modular combinational circuits with MUX / DEMUX, Decoder & Encoder
 3. Design & analyze synchronous sequential logic circuits
 4. Analyze various logic families.
 5. Design ADC and DAC and implement in amplifier, integrator, etc.
-

KEC303	Network Analysis and Synthesis	3L:0T:0P	3 Credits
---------------	---------------------------------------	-----------------	------------------

Unit	Topics	Lectures
I	Node and mesh analysis, matrix approach of network containing voltage & current sources and reactances, source transformation and duality.	8
II	Network theorems: Superposition, reciprocity, Thevenin's, Norton's, Maximum power transfer, compensation and Tellegen's theorem as applied to A.C. circuits.	8
III	Trigonometric and exponential Fourier series: Discrete spectra and symmetry of waveform, steady state response of a network to non-sinusoidal periodic inputs, power factor, effective values, Fourier transform and continuous spectra, three phase unbalanced circuit and power calculation.	8
IV	Laplace transforms and properties: Partial fractions, singularity functions, waveform synthesis, analysis of RC, RL, and RLC networks with and without initial conditions with Laplace transforms evaluation of initial conditions.	8
V	Transient behaviour, concept of complex frequency, driving points and transfer functions poles and zeros of immittance function, their properties, sinusoidal response from pole-zero locations, convolution theorem and two four port network and interconnections, behaviour of series and parallel resonant circuits, introduction to band pass, low pass, high pass and band reject filters.	8

Text/Reference Books

1. Franklin F. Kuo, "Network Analysis and Synthesis," Wiley India Education, 2nd Ed., 2006.
2. Van, Valkenburg, "Network analysis," Pearson, 2019.
3. Sudhakar, A., Shyamohan, S. P., "Circuits and Network," Tata McGraw-Hill New Delhi, 1994.
4. A William Hayt, "Engineering Circuit Analysis," 8th Edition, McGraw-Hill Education.
5. A. Anand Kumar, "Network Analysis and Synthesis," PHI publication, 2019.

Course Outcomes:

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

1. Understand basics electrical circuits with nodal and mesh analysis.
 2. Appreciate electrical network theorems.
 3. Apply Laplace transform for steady state and transient analysis.
 4. Determine different network functions.
 5. Appreciate the frequency domain techniques.
-

KEC351	Electronic Devices Lab	0L:0T:2P	1 Credits
---------------	-------------------------------	-----------------	------------------

SUGGESTIVE LIST OF EXPERIMENTS

1. **Study of Lab Equipment and Components:** CRO, multimeter, and function generator, power supply- active, passive components and bread board.
2. **P-N Junction diode:** Characteristics of PN junction diode - static and dynamic resistance measurement from graph.
3. **Applications of PN Junction diode:** Half & Full wave rectifier- Measurement of V_{rms} , V_{dc} , and ripple factor.
4. **Characteristics of Zener diode:** V-I characteristics of Zener diode, graphical measurement of forward and reverse resistance.
5. **Characteristics of Photo diode:** V-I characteristics of photo diode, graphical measurement of forward and reverse resistance.
6. **Characteristics of Solar cell:** V-I characteristics of solar cell, graphical measurement of forward and reverse resistance.
7. **Application of Zener diode:** Zener diode as voltage regulator. Measurement of percentage regulation by varying load resistor.
8. **Characteristic of BJT:** BJT in CE configuration- graphical measurement of h-parameters from input and output characteristics. Measurement of A_v , A_i , R_o and R_i of CE amplifier with potential divider biasing.
9. **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.
10. **Metal Oxide Semiconductor Field Effect Transistors:** Single stage MOSFET amplifier –plot of gain in dB Vs frequency, measurement of, bandwidth, input impedance, maximum signal handling capacity (MSHC) of an amplifier.
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.

Course outcomes:

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

1. Understand working of basic electronics lab equipment.
 2. Understand working of PN junction diode and its applications.
 3. Understand characteristics of Zener diode.
 4. Design a voltage regulator using Zener diode.
 5. Understand working of BJT, FET, MOSFET and apply the concept in designing of amplifiers.
-

KEC352	Digital System Design Lab	0L:0T:2P	1 Credits
---------------	----------------------------------	-----------------	------------------

SUGGESTIVE LIST OF EXPERIMENTS

1. Introduction to digital electronics lab- nomenclature of digital ICs, specifications, study of the data sheet, Concept of Vcc and ground, verification of the truth tables of logic gates using TTL ICs.
2. Implementation of the given Boolean function using logic gates in both SOP and POS forms.
3. Verification of state tables of RS, JK, T and D flip-flops using NAND & NOR gates.
4. Implementation and verification of Decoder using logic gates.
5. Implementation and verification of Encoder using logic gates.
6. Implementation of 4:1 multiplexer using logic gates.
7. Implementation of 1:4 demultiplexer using logic gates.
8. Implementation of 4-bit parallel adder using 7483 IC.
9. Design, and verify the 4-bit synchronous counter.
10. Design, and verify the 4-bit asynchronous counter.
11. Implementation of Mini Project using digital integrated circuits and other components.

Course outcomes:

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

1. Design and analyze combinational logic circuits.
 2. Design & analyze modular combinational circuits with MUX/DEMUX, decoder, encoder.
 3. Design & analyze synchronous sequential logic circuits.
 4. Design & build mini project using digital ICs.
-

KEC353	Network Analysis and Synthesis Lab	0L:0T:2P	1 Credits
---------------	---	-----------------	------------------

SUGGESTIVE LIST OF EXPERIMENTS

1. Verification of Kirchhoff's laws.
2. Verification of Superposition theorem.
3. Verification of Thevenin's Theorem and Maximum power transfer theorem.
4. Verification of Tellegen's theorem.
5. Measurement of power and power factor in a single phase AC series inductive circuit and study improvement of power factor using capacitor.
6. Study of phenomenon of resonance in RLC series circuit and obtain resonant frequency.
7. Determination of parameters of AC single phase series RLC circuit.
8. To find poles and zeros of immittance function.
9. Design and find cut-off frequency of low pass and high pass filters.
10. Design and find the pass band frequencies of band pass filters.
11. Design and find the stop band frequencies of band reject filters.

Course Outcomes:

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

1. Understand basics of electrical circuits with nodal and mesh analysis.
 2. Appreciate electrical network theorems.
 3. Analyse RLC circuits.
 4. Determine the stability of an electrical circuit.
 5. Design network filters.
-

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 Approach , 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"/ Pearson Educations

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, Information 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 Filter 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”, 2nd Indian 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 α -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 with Advance 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. Framing in Time Division Multiplexing using optical fiber link.
8. To study the Manchester coding/Decoding used in optical fiber.
9. To study Voice Digitization: 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 of universal op-amp based biquad.
2. To analyse amplitude 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 other ICs.
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 other ICs.

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 and Networks”, 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	Learn principle, 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 3rd Edition,
3. Willard, Merritt, Dean and Settle, "Instrumental Methods of Analysis", 7th Edition, CBS Publishers.

REC082 ADVANCED DISPLAY TECHNOLOGIES & SYSTEMS

COURSE OBJECTIVE: Students undergoing this course are expected:

1. To understand properties of light.
2. To analyse Display 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 analyse Micro-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 of Colorant 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, Transmissive 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, Field 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, Transmissive Liquid Crystal Micro-display, MEMs Micro-display, DLP Projection Technology; Micro-display Applications: Projection Systems, Head Worn Displays; Electronic View Finders, Multifocus 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 launch vehicle, orbital effects, Introduction to geosynchronous and geostationary 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	<p>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</p> <p>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</p>	8
II	<p>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.</p> <p>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</p>	8
III	<p>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.</p>	8
IV	<p>VoIP and SS7 The SS7 Protocol Suite, SS7 Network Architecture, ISUP, Performance Requirements for SS7, SIGTRAN, Interworking SS7 and VoIP Architectures</p>	8
V	<p>Quality of Service The Need for QoS, Overview of QoS Solutions, The Resource Reservation Protocol, DiffServ, Multiprotocol Label Switching, Combining QoS Solutions</p>	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 Morgan, "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.