ELECTRONICS & COMMUNICATION ENGINEERING

Course Name	**:**	**INTRODUCTION TO ELECTRONICS & COMMUNICATION ENGINEERING**
Course Code	**:**	**ECN 101**
Credits	**:**	**2**
L T P	**:**	**2-0-0**

Course Objectives:
To familiarize the students with the evolution and basics of electronics and communication engineering. To introduce the various fields of electronics and communication and their applications.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ELECTRONICS:** History of Electronics Engineering, Applications of electronics, Electronic components	4
2	**DIGITAL PRINCIPLES:** Digital waveforms, digital logic, moving and storing digital information, digital operations, digital integrated circuits	5
3	**COMMUNICATION PRINCIPLES:** Introduction to communication system, communication time line, elements of communication system, time and frequency domain, different types of noise, Electromagnetic spectrum and allocations	6
4	**MAJOR FIELDS OF ELECTRONICS & APPLICATIONS:** Signal processing, telecommunication engineering, control system engineering, Embedded systems, VLSI design engineering.	13

Course Outcomes:	
1	Students will be able to understand the fundamentals of electronics and communication.
2	Students will become aware of the various field of electronics and communication engineering along with their applications.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital principles & applications, Malvino Leach, TMH	2011
2	Electronic Communication Systems, R.Blake, Cengage Learning	2002
3	Electronic devices & Circuits, J.Millman, C.C.Halkias. Mc.Hill.	2008
4	CMOS digital integrated circuits: Analysis & Design, Sung-MO Kang, Y. Leblebici, TMH	2006
5	Embedded Systems, Raj Kamal, TMH.	2008
6	Control Systems Engineering., Nagrath & Gopal, New Age International.	2006

Course Name	**:**	**ANALOG ELECTRONIC CIRCUITS -I**
Course Code	**:**	**ECN 102**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
At the end of this course, the student should be able to identify active and passive components and to solve simple electronic circuits. The student should also be able to explain construction, operation, characteristics and biasing of diodes, transistors and FETs. The student should also be able to analyze the mathematical models of transistor amplifier circuits and describe the operation of feedback amplifiers, oscillators and power amplifiers.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**CIRCUIT THEORY FUNDAMENTALS** Electrical quantities, Electrical components, Circuit laws and theorems, Circuit analysis, Measurement equipment	5
2	**DIODES AND DIODE CIRCUITS** Diode, Diode models, Diode ratings, Rectifier circuits, Clippers, Clampers, Special purpose diodes- Zener diode, Tunnel diode, Varactor Photodiode, Light Emitting diode, Schottky diode, PIN diode.	5
3	**BIPOLAR JUNCTION TRANSISTORS** Junction transistor, Regions of operation, Transistor configurations, Current components in a transistor, Transistor as an amplifier, characteristics of CB, CE and CC configuration.	3
4	**TRANSISTOR AND ITS BIASING:** Load line and Operating point, Bias stability, various biasing circuits, stabilization against variation in Ico, V_{be} and beta, Bias compensation, Thermistor and Sensistor compensation, Thermal Runaway, Thermal stability.	6
5	**BJT MODELING:** Transistor as an amplifier, comparison of CB, CC and CE amplifier stages, BJT modeling, Important parameters: Input Impedance, Output Impedance, voltage and current gain, Transistor h–parameters, conversion formulas, $r_e$model, analysis of transistor amplifiers using h-parameters.	8
6	**BJT FREQUENCY RESPONSE:** Frequency Response of single stage CE amplifier, Multistage amplifiers, Direct coupled, RC coupled and Transformer coupled, frequency response of multistage amplifiers, cascode circuits.	6
7	**FIELD EFFECT TRANSISTORS:** Introduction, FET Construction, types of FET, Characteristics of FETs, MOSFET: types and working principle, FET biasing, FET small signal model, FET applications.	4
8	**POWER AMPLIFIERS:** Classification of amplifiers, Single tuned and double tuned amplifiers, analysis of class A, B, C and AB amplifiers, push pull amplifier, complementary symmetry, amplitude distortion in amplifiers, harmonics, power distortion, heat sinks.	5

List of Experiments: ANALOG ELECTRONIC CIRCUITS – I (LAB)		Number of Turns
1.	To study electronic components and usage of multimeter for various measurements.	1
2.	To study CRO and function generator and their usage.	1
3.	To study the V-I characteristics of pn junction diode and determine static resistance and dynamic resistance.	1
4.	To simulate and implement clipper and clamper circuits.	2
5.	To simulate and implement half wave and full wave rectifier.	1
6.	Verification of Network theorems: Superposition Theorem, Thevenin's Theorem	2
7.	Verification of Network theorems: Maximum Power Transfer Theorem and Reciprocity Theorem	2
8.	To study the characteristics of BJT and FET.	2
9.	To simulate and verify the operation of BJT as an amplifier and draw the frequency response.	2

Course Outcomes: At the end of this course, the student will be able to	
1	Describe the behavior of electronic devices such **as** diodes, transistors and FETs.
2	Explain the frequency response of BJT amplifier.
3	Compare the various configurations of feedback amplifiers and different types of oscillator circuits.
4	Demonstrate the capability to apply the theoretical concepts for the designing of practical circuits.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Integrated Electronics, Millman & Halkias, TMH.	2008

2	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky, PHI	2009
3	Circuits and Networks: Analysis and Synthesis, Sudhakar and ShyamMohan, TMH	2009
4	Microelectronic Circuits, AS Sedra & KC Smith, OXFORD	2010
5	Electronics Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill	2008

Course Name	**:**	**DIGITAL DESIGN**
Course Code	**:**	**ECN 103**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
At the end of this course, the student should be able to demonstrate the ability to use logic gates, Basic Boolean laws, minimization techniques for the designing of various combinational circuits. The student should also be able to describe operation, characteristic equations, excitation table of various flip flops and explain the conversion of flip flops. Design and analyze sequential circuits from the basic building blocks and describe memories, A/D, D/A Converters, Logic families and their characteristics.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**BOOLEAN ALGEBRA AND LOGIC GATES** Theorem of Boolean algebra, reducing Boolean expressions, logic gates, Universal building blocks- NAND and NOR gates, logic diagram, converting circuit to universal logic, positive and negative logic.	3
2	**MINIMIZATION TECHNIQUES** Sum of Products and Products of Sum forms, Minterms & Maxterms, Karnaugh Map for two, three, four five and six variables, Quine-McCluskey method	6
3	**COMBINATIONAL CIRCUIT DESIGN** Half adder, full adder, subtractor, BCD adder, comparator, code converter, encoder decoder, multiplexer, demultiplexer, parity detector and generator	6
4	**FLIP FLOPS** 1-bit memory cell, clocked and unclocked flip flops, S-R Flip flop, D flip flop, JK Flip flop, T flip flop, edge triggered flip flop, race around condition , Master slave flip flop, conversion of flip flops.	4
5	**COUNTERS AND SHIFT REGISTERS** Ripple counter, design of Mod-N ripple counter, design of synchronous sequential circuits, State machines, synchronous counter, decade counter, ring counter, Johnson counter, serial in serial out shift register, serial in parallel out shift register, parallel in serial out shift register and parallel in parallel out shift register, bidirectional shift register, universal shift register.	8
6	**DIGITAL MEMORIES & PROGRAMMABLE LOGIC** ROM, RAM (static and dynamic), PROMS, PLA and PAL	4
7	**A/D AND D/A CONVERTERS** Weighted resistor D/A converter, Binary ladder D/A converter. A/D Converters- flash type, successive approximation, counter ramp type, dual slope type, characteristics of ADC and DAC.	6
8	**LOGIC FAMILIES** Characteristics of logic families, RTL, TTL, ECL, DTL, DCTL, I^2L, HTL, CMOS logic families.	5

List of Experiments:		**Number of Turns**
1	To Study the data sheets of TTL and ECL.	**1**

2	To investigate the logic behavior of various logic gates (NAND, NOR, NOT, AND, OR, XOR)	**1**
3	To simulate and Implement a logic function using logic gates.	**1**
4	To design, simulate and Implement Adder and Subtractor circuits.	**1**
5	To design, simulate and implement code converters.	**2**
6	To design, simulate and implement combinational circuits using Multiplexers.	**1**
7	To simulate and implement Flip-flops using NAND and NOR Gates.	**1**
8	To study the operation of shift register.	**1**
9	To study the operation of counter ICs.	**1**
10	To design, simulate and implement the synchronous sequential circuits.	**2**
11	To design an application based on digital circuits.	**2**

Course Outcomes:	
1	Identify the components and design combinational and sequential circuits using them.
2	Compare the different logic families, memories and A/D-D/A converters.
3	Design an application based on digital circuits.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital Design by Morris Mano, PHI, 4th edition	2008
2	Digital principles and Applications, by Malvino Leach, TMH	2011
3	Digital System Principles and Applications, by R J Tocci (PHI)	2009
4	Modern Digital Electronics, by R P Jain, TMH	2006
5	Digital Integrated Electronics, by Taub Schilling, TMH	2004

Course Name	**:**	**COMMUNICATION ENGINEERING**
Course Code	**:**	**ECN 201**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:

By the end of this course, the students should be able to analyse a transmission line, do transmission line calculations using smith chart, design rectangular and circular waveguides, explain various analog modulation techniques, their generation and detection, and enlist the various functional blocks in analog communication receiver and transmitter. The students should also be able to describe the basic radiating antennas, antenna arrays, calculate the basic antenna parameters, and identify antenna specifications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1.	**TRANSMISSION LINES:** Concept of Distributed elements, Equations of Voltage and Current, Types of Transmission lines, Standing Waves and Impedance Transformation, Lossless and Low loss Transmission lines, Power transfer on a transmission line, Transmission line calculations using Smith Chart ,Applications of transmission lines	7
2.	**WAVEGUIDES:** Rectangular Waveguides, Field analysis and characteristics of TE and TM modes, Losses in waveguides, Circular waveguides	7
3.	**INTRODUCTION TO COMMUNICATION SYSTEMS:** Principles of Communication Signal to Noise Ratio, Channel Bandwidth, Rate of	2

	Communication, Modulation.	
4.	**AMPLITUDE MODULATION:** Base band and carrier communication, Amplitude modulation: Double side Band (DSB), Single Side Band (SSB), Vestigial Sideband (VSB), AM Receiver.	7
5.	**ANGLE MODULATION:** Concept of Instantaneous Frequency, Bandwidth of Angle Modulation, Generation of FM wave, Demodulation of FM, Interference of Angle Modulated Systems, FM Receivers.	7
6.	**PULSE MODULATION SYSTEMS:** Sampling theorem, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Pulse Code Modulation, Differential PCM, Delta Modulation, Adaptive Delta Modulation.	4
7.	**ANTENNAS AND WAVE PROPOGATION :** The Potential Functions, Elemental Dipole Antennas (The Electric (Hertzian) Dipole, Magnetic Dipole (Loop), Antenna Characteristics, The Long Dipole and Monopole Antennas, Antenna Arrays, Antenna Directivity and Gain, Antenna Coupling, The Friis Transmission Equation, Effect of Ground Reflections on Signal Transmission, Introduction to wave propogation.	8

Course Outcomes: By the end of this course, the students will be able to	
1.	Calculate the basic transmission line parameters, mathematically and using the Smith chart and design impedance matching devices.
2.	Analyse and design rectangular and circular waveguides.
3.	Explain the block diagram of analog communication system and various modulation techniques.
4.	Compute antenna parameters and draw radiation patterns.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1.	Electronic Communication Systems by G. Kennedy And B. Davis, Mc Graw Hill, 4th Edition	2006
2.	Elements of Electromagnetics by Mathew N.O. Sadiku, Oxford, Sixth Edition	2014
3.	Modern Digital & Analog Communication Systems by B.P. Lathi, Oxford University Press,4th Edition	2009
4.	Electronic Communications,4th Edition, Roddy &Coolen, Prentice Hall	1995
5.	Electromagnetic Waves by RK Shevgaonkar, Tata McGraw-Hill Education	2005
6.	Electromagnetic Waves & Radiating Systems, 2nd Edition by Jordan& Balmain	1968

Course Name	**:**	**SIGNALS AND SYSTEMS**
Course Code	**:**	**ECN 202**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:

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

Analyze continuous and discrete time signals and systems.

Analyze communication systems in time and frequency domain.

Comprehend signals based on Fourier transform and study the impulse response of RC &RL networks, pulse response of RL, RC networks.

Total No. of Lectures – 42

Lecture wise breakup	**Number of Lectures**

1	**CONTINUOUS TIME SIGNALS :** Signals and their classification, size of the signal, continuous and discrete time signal properties-periodicity, absolute integral, convolution, Hilbert transform, signal operations on elementary CT/DT signals, Shifting, flipping, multiplication.	10
2	**DISCRETE TIME SIGNALS:** Sampling, Aperiodic signal representation by Fourier integral, concept of continuous and discrete spectrum, essential and absolute bandwidth, correlation, auto-correlation and cross-correlation and their properties, energy spectral density, power spectral density, calculation of the energy and power signal respectively, properties of Fourier transform and applications, Discrete time Fourier transform(DTFT), Inverse DTFT.	10
3	**SYSTEMS** Systems and their classification, Linear Time invariant systems and its properties, stability and causality, linear constant coefficients, difference equation, Z-Transform and its properties, inverse z transform, Examples. Continuous and discrete time systems and their applications, band pass signals, band pass systems.	8
4	**TIME AND FREQUENCY DOMAIN ANALYSIS** Representation of basic circuits in terms of generalized frequency and their response, step response of RL, RC, RLC circuits, impulse response of RC & RL networks, pulse response of RL, RC networks.	6
5	**INFORMATION THEORY:** Concept of information, Entropy, Rate of Information Transmission, Redundancy, Efficiency and Channel capacity-Coding theory-Minimum Redundancy Coding-continuous channel, Transmission Rate and Capacity of Continuous Channels	8

Course Outcomes: By the end of this course student will be able to:	
1	Explain in detail continuous and discrete signals and systems and solve problems based on them
2	Solve different types of problems based on z transform and discrete time fourier transform
3	Solve problems relevant to communication channel, capacity and coding

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Modern Digital & Analog Communication Systems by B.P. Lathi, pub. Oxford Univ. Press, 3rd Edition	2009
2	Signal And System by M.J. Robert, TMH, Third Edition.	Latest Edition
3	Signals and systems by A.V. Oppenheim & A.S. willisky, 2nd edition, Pearson education.	Latest Edition
4	Introduction to Communication Theory by P.D. Sharma	Latest Edition
5	Circuits and Networks (Analysis and synthesis):- Sudhakar, Shyammohan	Latest Edition

Course Name	**:**	**MICROPROCESSOR AND APPLICATIONS**
Course Code	**:**	**ECN-203**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:

At the end of the course, the students should be able to explain the architecture of 8086 microprocessors, analyse the programming techniques. The students should also be able to demonstrate various interfacing techniques and design a microprocessor based application.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**MICROPROCESSOR 8086:** Introduction to Microprocessors and Microcomputers, 8086 Microprocessor architecture, Pin configuration, Register organisation of 8086, physical memory organisation, General bus operation, Special processor activities, Minimum Mode 8086 System and Timings, Maximum Mode 8086 System and Timings.	6
2	**INSTRUCTION SET AND ASSEMBLER DIRECTIVES:** Machine Language Instruction Formats, Addressing Modes of 8086, Instruction Set of 8086, Assembler Directives and Operators.	7
3	**ASSEMBLY LANGUAGE PROGRAMMING WITH 8086:** Machine Level Programs, Machine Coding the Programs, Programming with an Assembler, Assembly Language Example Programs.	6
4	SPECIAL ARCHITECTURAL FEATURES AND RELATED PROGRAMMING: Introduction to stack, stack Structure of 8086, Interrupts and Interrupt Service Routines, Interrupt Cycle of 8086, Non Maskable Interrupt, Maskable Interrupt, Interrupt Programming, MACROS, Timings and Delays.	6
5	**BASIC PERIPHERALS AND THEIR INTRFACING WITH 8086** Semiconductor Memory Interfacing, Dynamic RAM Interfacing, Interfacing I/O Ports, PIO 8255 (Programmable Input-Output Port), Modes of Operation of 8255, Interfacing Analog to Digital Data Converters, Interfacing Digital to Analog Data Converters.	7
6	**SPECIAL PURPOSE PROGRAMMABLE PERIPHERAL DEVICES AND THEIR INTERFACING:** Programmable Interval Timer 8253, Introduction to Serial Communication, Programmable Communication Interface 8251.	5
7	**NUMERIC DATA PROCESSOR (8087)** Pin configuration, NDP data types, Processor architecture, interfacing with 8086, Exceptions, Instruction set.	5

List of Experiments:		**Number of Turns**
1	8086 based experiments for data transfer operations.	2
2	8086 based experiments for arithmetic operations.	2
3	8086 based experiments for logical operations.	2
4	8086 based experiments for sorting.	2
5	8086 based experiments for data conversions.	3
6	8086 based experiments for interfacing various addon cards	3

Course Outcomes: By the end of this course student will be able to:	
1	Explain the functioning of microprocessor.
2	Do projects based on interfacing.
3	Evaluate the programming skills.
4	Identify the importance of Assembler Directives and Operators

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Advanced Microprocessors & peripherals by A K Ray & K M Bhurchandi, TMH Publication.	2013
2	Microprocessors and Peripherals by- B.Brey, CBS.	1989

Course Name	**:**	**ANALOG ELECTRONIC CIRCUITS –II**
Course Code	**:**	**ECN 204**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
By the end of this course, the students should be able to design and analyze feedback amplifier and oscillator circuits, explain basic building blocks of operational amplifier, their functioning and demonstrate its various applications in analog systems. The students should also be able to classify various filters and their design and describe the working of multivibrators and operating principle of Phase locked loop.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1.	**FEEDBACK AMPLIFIERS AND OSCILLATORS:** Concept of feedback, Positive and negative feedback, Voltage and current feedback, Series and shunt feedback, Effect of feedback on performance characteristics of an amplifier. Basic principles of sinusoidal oscillators, tuned collector, tuned base, Hartley oscillator, Colpitt's Oscillator, Phase Shift Oscillator, Wein Bridge Oscillator, Crystal Oscillator, Frequency stability of Oscillator.	10
2.	**OPERATIONAL AMPLIFIERS:** Differential amplifier, cascaded differential amplifier, block diagram of a typical Opamp, Ideal Opamp, Open loop Opamp configurations, Opamp Characteristics, closed loop Opamp configurations, voltage series feedback or Non inverting amplifier, Voltage shunt feedback or inverting amplifier.	6
3.	**APPLICATIONS OF OP-AMP:** Summing scaling and averaging amplifiers, Subtractor, voltage to current converter, current to voltage converter, Integrator, Differentiator, Comparator, Instrumentation Amplifier.	5
4.	**NON LINEAR CIRCUITS:** Comparator, Zero crossing detector, Schmitt trigger, Logarithmic and antilogarithmic amplifiers, Precision rectifiers, Sample and Hold circuit, Clippers and clampers using Opamp, Peak detector.	4
5.	**ACTIVE FILTERS:** Filter specifications, design of low pass, high pass, band pass and band reject filters using operational amplifiers; Design of Butterworth and Chebyshev filters, higher order filters; State variable filters.	7
6.	**MULTIVIBRATORS:** Switching action of a transistor, Transistor switching times, MOSFET as a switch, Multivibrators-Monostable, Bistable, Astable, Unsymmetrical/symmetrical triggering, Schmitt trigger, 555 timer-block diagram and working, 555 timer as monostable, astable and bistable multivibrator.	7
7.	**PHASE-LOCKED LOOP:** Operating Principle, PLL Operation and PLL applications	3

List of Experiments: ANALOG ELECTRONIC CIRCUITS – II (LAB)		**Number of Turns**
1	Opamp as summing and difference amplifier.	1
2	Opamp as integrator & differentiator.	1
3	Opamp as high pass, low pass and Bandpass filter	3
4	Clipper, clamper and comparator using Opamp	2
5	Astable, monostable and bistable multivibrator using 555 timer	3
6	MOSFET as switch	1
7	Simulation of feedback amplifiers and oscillator circuits.	3

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

1	Describe the fundamentals of feedback amplifiers and oscillators.
2	Draw outputs of the wave shaping circuits and explain operational amplifier along with its applications.
3	Identify the multivibrator circuits and explain the basic principle of phase locked loop.
4	Demonstrate the working behavior of devices and circuits and their applications.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Op-amps and linear integrated circuits by Ramakant A Gayakward Prentice hall 4th edition	2000
2	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky, PHI	2008
3	Microelectronic Circuits, AS Sedra & KC Smith, OXFORD	2003
4	Electronics Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill	2009

Course Name	**:**	**ENGINEERING ANALYSIS AND DESIGN**
Course Code	**:**	**ECN 206**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
At the end of this course, the students should be able to familiarize with the new concepts towards simulation and automation. The students should also be able to demonstrate to control any device by interfacing a computer.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1.	**INTRODUCTION TO SYSTEM MODELLING** Basic simulation modeling review of probability and statistics, random number generation.	**8**
2.	**PROGRAMMING & SIMULATION WITH LAB VIEW** Components, tools, controls & indicators, Local and Global variables, shift registers, formula node, arrays & clusters, data acquisition, instrument interfacing, interfacing of sensors, design of combinational and sequential circuits. applications based on lab view.	**15**
3.	**PROGRAMMING AND SIMULATION WITH MATLAB** Introduction to MATLAB, data types, 2D-3D plotting, histogram, polar plots, matrix manipulation, 2D-3D matrix visualization, spectral analysis of various signals, solving linear / non linear equations, system design & simulation with SIMULINK, use of Communication & Signal Processing tool boxes.	**15**
4.	**CASE STUDIES** Based on Analog / Digital Circuits	**4**

List of Experiments:		**Number of Turns**
1.	Write a program to count Modulus 32 and display the values in decimal, Hexadecimal, octal and binary.	**1**
2.	Set up a temperature simulator. Set up over and under temperature LEDs to light up whenever the deviation is>5ºC. The loop should operate once every second.	**1**
3.	Build a Four-Function Calculator.	**1**
4.	Build a VI to compute and display the linear equation.	**1**
5.	Write a simple program to generate a Voltage at Analog Output 0 using a knob to select the voltage. Verify using a multimeter.	**1**
6.	Design an astable multivibrator circuit and verify the frequency of its output signal by using ELVIS instrument.	**1**

7.	Spectral analysis of various types of signals.	**1**
8.	Generation of Digital Signals.	**1**
9.	Design & Simulation of Filters.	**2**
10.	Design & Simulation of Various Modulation and Demodulation circuits such as AM, FM, PM, ASK, PSK, FSK.	**2**
11.	Simulation of Digital Controllers.	**1**

Course Outcomes: By the end of this course, the students will be able to:	
1	Model a given system
2	Describe the fundamentals of lab view and design & simulate a given system.
3	Analyze, design & simulate various electronic circuits.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Simulation Modelling and Analysis, Averill M.Law and W.David Kelton, McGraw Hill Publications.	**Latest Edition**
2	Getting Started with MATLAB by Rudra Pratap, Oxford University Press.	**Latest Edition**
3	Virtual Instrumentation using Lab View, Electrical Engineering Series by Sanjay Gupta & J.John, Tata McGraw Hill	**Latest Edition**

Course Name	**:**	**COMPUTER NETWORKS**
Course Code	**:**	**ECN 207**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to define the basic concepts of Data communication with different models, classify and compare the physical layer, Data Link Layer, Network Layer and Transport Layer and their functions. The students should also be able to summarize the switching concept, its different types and explain the working of various types of wireless networks and their protocol.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**OVERVIEW OF DATA COMMUNICATION AND NETWORKING**: Data communications, Networks, The Internet, Protocols and standards, Layered tasks, OSI model, TCP /IP protocol Architecture, History of the computer network	3
2	**PHYSICAL LAYER:** Data rate limit, Transmission impairments, Line coding, Block coding, Sampling, Transmission mode, Modulation of digital data, Telephone modems, Modulation of analog signal, FDM, WDM, TDM, Guided media, Unguided media	5
3	**DATA LINK LAYER:** Types of errors, Detection, Error correction, Flow and error control, Stop and wait ARQ, go back n ARQ, Selective repeat ARQ, HDLC, Point to point protocol, PPP stack, Random access, Controlled access, Channelization, Traditional Ethernet, Fast Ethernet, Gigabit Ethernet	8
4	**NETWORKING AND INTERNETWORKING DEVICES:** Repeaters, Bridges, Type of Bridges, Routers, Routing concepts, Gateways, Internetworks, ARP, IP, ICMP, IPV6, Unicast routing, Unicast routing protocol, Multicast routing,Multicast routing protocols, introduction to Security, Cryptography, and SSL, Security - firewalls,	8

	DoS, etc.	
5	**TRANSPORT LAYER:** Process to process delivery, User datagram protocol (UDP), Multiplexing and Demultiplexing, Connection less transport (UDP), Principles of reliable data transfer, Transmission control protocol (TCP), Data traffic, Congestion, Congestion control, Quality of service	5
6	**APPLICATION LAYER:** DNS, Electronics mail architecture and services, message formats and transfers, WWW architectural overview, static and dynamic web pages, HTTP, Digital audio and video	4
7	**WIRELESS NETWORKS:** Cordless system, Wimax and IEEE 802.16 broadband wireless access standards, Mobile IP, Wireless Application Protocol, IEEE 802 Architecture, IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical Layer, Other IEEE 802.11 Standards, Wi-Fi Protocol Access, Bluetooth and IEEE 802.15, ad-hoc wireless, and sensor networks.	5
8	**SWITCHING:** Circuit Switching, Space division switching, Time division switching, Space and time division switching combinations, Packet switching, Data gram approach, Virtual circuit approach, message switching, Network Layer connection oriented and connectionless services, ATM, ISDN, MPLS, GMPLS.	4

Course Outcomes: By the end of this course, the students will be able to	
1	Describe the computer network system and its communication.
2	Identify and compare the various layers of a computer network model, their role and characteristics.
3	Explain various routing algorithms and switching concepts.
4	Identify the various wireless network models.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Introduction to Data Communication & Networking by Behrouz Forouzan, Tata McGraw Hill Edition	2012
2	Data and Computer Communications by William Stallings PHI 8th Edition.	2007
3	Data Communication and Distributed Networks, Ulylers D. Black, PHI 3rd ed.	1999
4	Computer Networks, Andrew S.Tanenbaum, , PHI 2nd ed.	2000

Course Name	**:**	**VLSI DESIGN**
Course Code	**:**	**ECN 208**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
By the end of this course, the students should be able to explain the MOS physics and its scaling effects, describe the fabrication process and mask designing of VLSI circuits. The students should also be able to design the basic CMOS circuits like inverters, combinational and sequential circuit, classify the static and dynamic behavior of CMOS circuits and compare the operation of semiconductor memories.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**PHYSICS AND MODELING OF MOSFETS**: Basic MOSFET Characteristics – Threshold Voltage,Body Bias concept, Gradual Channel	8

	Approximation, Current-Voltage Characteristics – Square-Law Model, MOSFET Modeling – Drain-Source Resistance, MOSFET Capacitances, Short Channel Effects, Geometric Scaling Theory and its effects– Full-Voltage Scaling, Constant-Voltage Scaling.	
2	**FABRICATION AND LAYOUT OF CMOS INTEGRATED CIRCUITS:** Overview of Integrated CircuitProcessing – Oxidation, Photolithography, Self-Aligned MOSFET, Isolation and Wells – LOCOS, Trench Isolation, CMOS Process flow, Stick Diagram and Layout – MOSFET Dimensions, Design Rules, Latch-up.	4
3	**MOS INVERTERS:** CMOS Inverter: Resistive load inverter, nMOS load inverter, CMOS inverter, switching threshold and noise margin concepts and their evaluation, switching characteristics- delay time calculation.	7
4	**COMBINATIONAL MOS LOGIC CIRCUITS:** Switching Properties of MOSFETs: nMOSFET/ pMOSFET Pass Transistors, Transmission Gate Characteristics, MOSFET Switch Logic, TG-based Switch Logic, MOS and CCOS logic circuits, Power Dissipation in CMOS Digital Circuits	5
5	**DYNAMIC LOGIC CIRCUIT CONCEPTS AND CMOS DYNAMIC LOGIC FAMILIES:** Charge Leakage, Charge Sharing, Dynamic RAM Cell, Bootstrapping, Clocked-CMOS, Pre-Charge/ Evaluate Logic, Domino Logic, Multiple-Output Domino Logic, NORA Logic, Single-Phase Logic.	8

List of Experiments:		**Number of Turns**
1	Familiarization with Simulation Softwares for schematic and layout entry, circuit simulation	2
2	DC transfer Characteristics of Inverters, Transient response, Calculating propagation delays, rise and fall times	2
3	Implementation of Boolean logic using S-Edit for static logic.	2
4	Implementation of Boolean logic using L-Edit for static logic, Design Rule Check (DRC), Electrical Rule Check (ERC) generation of layout and extraction.	2
5	Design of flip-flops, counters, registers using HDL	2
6	Design of state machines using HDL at various abstraction levels	2
7	Creating test benches, Synthesis using FPGA kits	2

Course Outcomes: By the end of this course, the students will be able to	
1	Describe the Physics of MOS device.
2	Classify the CMOS process technology and layout design.
3	Identify the characteristics of CMOS circuits and will be able to design the CMOS circuits using VLSI CAD tools.
4	Compare between static and dynamic CMOS logic circuits.
5	Classify the various semiconductor memories.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	CMOS Digital Integrated Circuits – Analysis and Design, S. Kang and Y. Leblebici, Tata McGraw Hill 3rd ed.	2008
2	CMOS VLSI Design: A Circuits and Systems Perspective, N.H.E. Weste and K. Eshraghian, Addision Wesley 2nd ed.	1998
3	Digital Integrated Circuits – A Design Perspective, J.M. Rabaey, A.P. Chandrakasen and B. Nikolic, Pearson Education 2nd ed.	2007
4	CMOS Circuit Design, Layout and Simulation, R.J. Baker, H. W. Lee, and D. E. Boyce, Wiley - IEEE Press 2nd ed.	2004

Course Name	**:**	**DIGITAL SIGNAL PROCESSING**
Course Code	**:**	**ECN 209**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
By the end of this course, students should be able to define concepts of DSP such as LTI Systems, stability, causality and differential equations, explain various transformation and design techniques and implementation of IIR and FIR filters.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**TRANSFORMATION OF DISCRETE SIGNALS** Typical applications of DSP, Discrete Fourier Transform(DFT) and its properties, IDFT, Fast Fourier Transform (FFT), Decimation in time and decimation in frequency algorithms, IFFT	8
2	**DIGITAL FILTERS** Recursive and non recursive systems, Frequency domain representation of discrete time systems, systems function, Ideal low pass filter	4
3	**DESIGN OF IIR FILTERS** Impulse invariance transformation technique, Bilinear transformation, Design of IIR Filters using Butterworth, chebyshev and elliptic filter , Digital frequency transformation	9
4	**DESIGN OF FIR FILTERS** Design of FIR filters using Window technique, frequency sampling technique, Equiripple Approx. technique, comparison of IIR and FIR filters	8
5	**REALIZATION OF DIGITAL SYSTEMS** Block diagrams and signal flow graphs for FIR and IIR systems, Direct form, cascade and parallel form realization of FIR and IIR systems.	4
6	**DSP PROCESSOR** Introduction to fixed point and floating point processors , architecture of a DSP processor	2
7	**MULTIRATE DSP & APPLICATIONS** Multirate DSP and its applications, Decimation, Interpolation, Sampling Rate Conversion	4
8	**ADAPTIVE WEINER FILTER** Adaptive Weiner filter & its application in echo cancellation and equalization	3

List of Experiments:		**Number of Turns**
1	Hands on Experience on MATLAB and generation of digital signals	1
2	Write a Program for Discrete Convolution, Impulse Response of finite and infinite signals	1
3	Determine and plot Fourier Transform (magnitude and phase) for the infinite duration sequence.	1
4	For a Given a Causal System determine Impulse Response.	1
5	Determine convolution of two signals.	1
6	Determine impulse response and unit step response of the given system.	1
7	Determine frequency response of any LTI system.	1
8	Determine DTFT of the given sequence and plot magnitude and phase response.	1
9	Design an FIR low pass filter for the given specifications and plot frequency response of the filter.	1
10	Design a LP Butterworth filter for the given specifications and plot frequency response of the filter.	1
11	Compute DFT and IDFT for the given signal.	1
12	Compute FFT of a real time input signal using DSP kits.	2

Course Outcomes: By the end of this course student will be able to:	
1	Define LTI systems transform ,DTFT ,FFT
2	Explain various design techniques of IIR and FIR digital filters
3	Explain the realization of IIR and FIR filters
4	Outline the concept of DSP processor

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital Signal Processing by Proakis & Manolakis, Pearson Education	Latest Edition
2	Digital Signal Processing by A.V Oppenheim and R.W.Schafer, Pearson Education	Latest Edition
3	Digital Signal Processing by E C Ifeachor and B W Jervis.	Latest Edition
4	Digital Signal Processing by S Salivahanan, A Vallavraj, C Gyanapriya, TMH	2011
5	Digital Signal Processing By S. K. Mitra, TMH	2010

Course Name	**:**	**COMMUNICATION THEORY**
Course Code	**:**	**ECN 210**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to evaluate the signals at input and output of a communication system and analyse the performance of basic communication system in terms of on signal transmission through linear networks and noise.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**RANDOM SIGNALS:** Definition of a random process, stationarity, ensemble averages, Power spectral density, cross spectral density, Gaussian process.	6
2	**RANDOM SIGNAL THEORY:** Probability, random variables, probability density, statistical moments, different density functions, sum of random variables, transformations of density functions, correlation functions, random processes, correlation functions of random processes, spectral density, white noise	9
3	**SIGNAL TRANSMISSION THROUGH LINEAR NETWORKS:** Convolution theorem, frequency domain analysis, bandpass networks, ideal transfer functions-amplitude distortion , phase distortion, optimum filters, matched filters, minimum mean square error criteria, calculation ,	9
4	**INPUT-OUTPUT RELATIONS WITH RANDOM INPUTS:** Probability density input-output relationships, equivalent noise bandwidth, envelope of sine wave plus gausian noise.	9
5	**NOISE AND INTERFERENCE:** Classification of noise, sources of noise, atmospheric noise, shot noise, thermal and white noise, noise spectral density, noise calculations, Noise Figure of Devices, Circuits and Cascaded Networks, Experimental Determination of NF, Noise Calculations for different Communication Systems.	9

Course Outcomes: By the end of this course, the students will be able to:	
1	Calculate a various parameters relevant to a communication system.
2	Comprehend the concept of filters in signal transmission through linear networks.
3	Formulate mathematical model of a communication system given a random signal.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Introduction to communication theory by P.D.Sharma, Publisher Nem Chand & Bros.	1971
2	Probability, Random variables and acoustic processes by Papoulis, S.Pillai, Tata McGraw Hill.	2014

Course Name	**:**	**COMPUTER ARCHITECTURE**
Course Code	**:**	**ECN301**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to identify and define the architecture and organization of the basic computer. The students should also be able to explain the role of different modules like control unit, central processing unit, input-output organization, memory unit in the organization of basic computer, solve computer arithmetic and define the concept of parallel processing.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**REGISTER TRANSFER AND MICRO OPERATIONS:** Register transfer Language, Register transfer, Bus & memory transfer, micro operations, Instruction codes, Computer instructions, Timing & control, Instruction Cycles, Memory reference instruction, Input /Output & Interrupts, Complete computer description & design of basic computer.	8
2	**CONTROL UNIT:** Hardwired vs. Micro programmed control unit.	4
3	**CENTRAL PROCESSING UNIT:** General register organization, Stack organization, Instruction format, Data transfer & manipulation, Program control, RISC, CISC.	7
4	**COMPUTER ARITHMETIC:** Addition & subtraction, Multiplication Algorithms, Division algorithms.	5
5	**INPUT-OUTPUT ORGANIZATION:** Peripheral devices, I/O interface, Data transfer schemes, Program control, Interrupt, DMA transfer, I/O processor.	7
6	**MEMORY UNIT:** Memory hierarchy, Processor vs. memory speed, Hard disk drive, High-speed memories, Cache memory, Associative memory, Interleave, Virtual memory, Memory management	8
7	**PARALLEL PROCESSING:** Types of parallel processors, performance considerations, pipeline processors, array processors	3

Course Outcomes: By the end of this course, the students will be able to	
1	Define the syntax of Register transfer Language and different micro operations.
2	Design and construct the instruction format & addressing modes for a given operation and algorithms for

	addition, subtraction, multiplication & division.
3	Explain the interdependence of different modules like control unit, CPU and I/O interface and their design aspects.
4	Summarize the working of different types of memories like associate memory, cache memory, virtual memory etc. and their mapping techniques.
5	Outline the concept of pipelining and multiprocessors.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Computer System Architecture, Morris M. Mano, Prentice Hall, 3rded.	1992
2	Computer Architecture and Organization, J.P. Hayes, McGraw Hill, 3rd ed.	1998
3	Computer Architecture A Quantitative Approach, J.L. Hennessy, D.A. Patterson and D. Goldberg , Pearson Education Asia, 5th ed.	2006
4	System Architecture: software and hardware concepts, W.E. Leigh, and D.L. Ali, South Wester Publishing Co.	2000

Course Name	**:**	**ADVANCED COMMUNICATION**
Course Code	**:**	**ECN 302**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
By the end of this course, the students should be able to gain knowledge and advancement in communication technology. The students should also be able to identify and compare various fields of advanced communication and their applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION** Digital communication system (description of different modules of the block diagram), Complex baseband representation of signals, Gram-Schmidt orthogonalization procedure. M-ary orthogonal signals, bi-orthogonal signals, simplex signal waveforms.	**6**
2	**DIGITAL MODULATION TECHNIQUES** Pulse amplitude modulation (binary and M-ary, QAM), Pulse position modulation (binary and M-ary), Carrier modulation (M-ary ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK).	**10**
3	**SATELLITE COMMUNICATION** Evolution and growth of communication satellites, Kepler's laws of motion, orbits, Altitude control; Satellite launch vehicles- Arianne, SLV space shuttle; Sub systems of communication satellite; Spectrum allocation and Bandwidth considerations; Propagation characteristics, Satellite transponders and other sub systems; Earth station technology; Analog and Digital link design; Multiple access techniques.	**10**
4	**OPTICAL COMMUNICATION** Characteristics of optical transmission media, Optical fibers – preparation and transmission characteristics, Loss and dispersion mechanisms, Optical sources – principles of operation, Modulation characteristics and Driver circuits, Photo detectors – Principles of operation, Fiber Optic communication Systems and Link budget using direct detection, Fiber optic connectors, Couplers, Multiplexers and splices, Multi-channel transmission, Optical amplifiers, Coherent and WDM systems.	**10**

5	**PRINCIPLES OF VIDEO COMMUNICATIONS TECHNICS** Basics of Telephony and Telegraphy. Introduction to Video Signals, Block diagram of TV transmitter and receiver system, Picture signal transmission, Positive and negative modulation, vestigial sideband transmission, Standard channel BW.	**6**

List of Experiments:		**Number of Turns**
1	Measure the baseband analog signal parameters in a wireless link.	1
2	Study the phenomenon of linear and circular polarization of antennas.	1
3	Measure the C/N ratio and propagation delay of signal in a satcom link.	1
4	To estimate, calculate and design of satellite link budget.	1
5	To simulate satellite system using Qualnet	2
6	To study and analyze Digital modulation techniques in time and frequency domain and their constellation view.	2
7	To measure numerical aperture and various types of losses in fiber.	1
8	Measurement of insertion loss, directivity, back reflection /return loss for a series of fiber optic components (i.e coupler, WDM, isolator, circulator, DWDM Mux/ Demux devices)	2
9	Designing of optical communication systems and photonic devices as per the given Specifications using simulation softwares. Ddo investigations in terms of BER, Eye diagram for systems and mode calculation for devices.	3

Course Outcomes: By the end of this course the student will be able to	
1	Describe advanced communication systems.
2	Apply the underlying principles for up-to-date examples of real world systems.
3	Emphasize on modern digital data transmission concepts and optimization of receivers.
4	Build a basis for subsequent related courses such as optical and satellite communications.
5	Identify audio and video transmission.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Principles of Communication Systems by Taub and Schilling Tata McGraw-Hill Education, 3rd edition	2008
2	Advanced Electronic Communication Systems Pearson (6th edition) by Wayne Tomasi	2009
3	Digital satellite communications (2nd Edition) by Tri T Ha, PHI	1990
4	Fiber-Optic Communications Technology (1stEdition)by Djafar K.Mynbaev and Lowell L. Scheiner, Prentice-Hall	2000
5	Modern Television Practice Principles, Technology and Servicing by R R Gulati (2nd Edition), New Age International	2002
6	Electronic Communications,4th Edition, Roddy &Coolen, Prentice Hall	1995

Course Name	**:**	**MICROWAVE & RADAR ENGINEERING**
Course Code	**:**	**ECN 303**
Credits	**:**	**4**
L T P	**:**	**3-1/2-2/2**

Course Objectives:
By the end of this course the student should be able to explain the evolution and basics of microwave engineering and characteristics of microwave devices. The student should also be able to describe radar systems , scanning and tracking techniques used in radar systems. They should also analyse various microwave devices, their characteristics and microwave measurements using test bench.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**MICROWAVE COMPONENTS** Attenuators and phase shifters, Bends, Corners, Twists, Flanges, Shorts, Matched loads, Tees (e-plane h plane & hybrid), Rat-race, Directional Couplers, Scattering matrix. Ferrite devices (isolator, circulator, gyrator), Cavity resonators.	**5**
2	**MICROWAVE MEASUREMENTS** Power and impedance measurement, Measurement of SWR, Frequency and wavelength.	**2**
3	**SOLID STATE SOURCES** Limitations of conventional solid state devices at microwave frequencies, Transistors (MESFET, HEMT), Diodes (tunnel, varactor, pin), transferred electron devices (GUNN), Avalanche transit time devices (IMPATT AND TRAPATT)	**9**
4	**MICROWAVE TUBES** Limitations of conventional tubes at microwave frequencies, Klystron amplifier, Reflex klystron, Magnetron, TWT, BWO, CFA'S.	**8**
5	**INTRODUCTION TO RADAR SYSTEMS** Basic principal block diagram and operation of radar, Radar range equation, PRF's, Range ambiguities. Applications of radar's.	**6**
6	**DOPPLER RADAR** Doppler determination of velocity, CW radar and its limitations, FM-CW radar, Basic principle and Operation of MTI radar, Delay line cancellers, Blind speeds and staggered PRF.	**7**
7	**SCANNING AND TRACKING TECHNIQUES** Various scanning techniques (horizontal, vertical, spiral, palmer, raster, nodding), Angle tracking system (lobe switching, conical scan, monopulse), Range tracking systems, Doppler (velocity) tracking systems.	**5**

List of Experiments:		**Number of Turns**
1	Plot the radiation characteristics of the horn antenna.	1
2	Draw the V-I characteristics of Reflex Klystron.	1
3	Measure the insertion loss and isolation of a circulator.	1
4	Plot the power output v/s frequency characteristics of a Gunn source.	1
5	Design an antenna and calculate Gain, directivity, antenna efficiency, bandwidth and 3 dB beam width using empirical formulas. Compare the simulated results obtained by software and theoretical results and Observe the effect of feed location on center frequency, return loss and bandwidth.	1
6	Design a Schottky diode at S Band frequencies structure using software.	1
7	Design a GaN MOSFET at K band using Software.	1

Course Outcomes: By the end of this course the student will be able to	
1	Study a wide range of Microwave components and their characteristics..
2	Describe radar systems , scanning and tracking techniques used in radar systems
3	Characterize Microwave devices in terms of the directionality of communication.
4	Use a Microwave test bench in analyzing various types of Microwave measurements.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Microwave devices and circuits (3rd Edition) by Samuel Liao, PHI	1996
2	Introduction to Radar systems (2nd Edition) by Merill I Skolnik,McGraw Hill.	2003
3	Microwave devices and Radar Engineering (3rd Edition) by Kulkarni,Umesh publications	2003
4	Foundation of Microwave Engineering (2nd Edition) by RE Collin; McGraw Hill	1992

Course Name	**:**	**WIRELESS COMMUNICATION**
Course Code	**:**	**ECN 304**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
By the end of this course, students should be able to familiarize with the evolution and basics of wireless communication technology, identify and explain various wireless systems, design aspects of cellular systems, VSAT systems and their applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO CELLULAR SYSTEMS:** A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular system, planning a cellular system, analog& digital cellular systems.	3
2	CELLULAR WIRELESS COMMUNICATION SYSTEM: Second generation cellular systems: GSM specification and air interface- specification of various units, GSM Architecture, 2.5 G systems: GPRS/EDGE specifications and features, 3G systems: UMTS & CDMA 2000 standards and specifications.	5
3	**ELEMENTS OF CELLULAR RADIO SYSTEMS DESIGN:** General description of the problem, Concept of frequency reuse channels, co-channel interference reduction factor, desired C/I from a normal case in an Omni directional antenna system, cell splitting, consideration of the components of cellular systems.	7
4	INTERFERENCE: Introduction to co-channel Interference, real time co-channel interference , co-channel measurement design of antenna system, antenna parameter and their effects, diversity receiver in co-channel interference- different types, Equalization, Equalization in Communication Receiver,, RAKE Receiver,Fundamental of Channel Coding.	6
5	**CELL COVERAGE FOR SIGNAL & TRAFFIC**: General introduction, Obtaining the mobile point to point mode, propagation over water or flat open area, foliage loss, propagation near in distance ,long distance propagation ,point to point prediction model characteristics, cell site, antenna heights and signal coverage cells, mobile to mobile propagation.	6
6	**CELL SITE ANTENNAS AND MOBILE ANTENNAS**: Characteristics, antenna at cell site, mobile antennas, Frequency Management and channel Assignment, Frequency Management, fixed channel assignment, non-fixed channel assignment, traffic & channel assignment.	5
7	**HAND OFF, DROPPED CALLS**: Why hand off, types of hand off and their characteristics, dropped call rates & their evaluation.	4
8	**EARTH STATION AND VSATS:** Spacecraft Structure, Primary Power, Various Subsystem of a Satellite, Transmitter, Receivers, Components of Earth Station, VSAT- type, Uses.	6

List of Experiments:		**Number of Turns**
1	To study GSM Architecture and network topologies	**2**
2	To study and estimate call flow(Voice and Data)	**1**
3	To comprehend the intra-circle roaming functionality	**1**
4	To estimate, calculate and design link budget.	1
5	To do frequency planning of the network along with neighbor definition	1
6	To estimate and design concept of frequency reuse	1
7	Create a scenario to study the bottleneck of the transmission rate of a link	1
8	To study optimization strategies to improve grade of service	1
9	To estimate various types of interference.	1
10	To study the effect of fading and measure the fading margin of a received signal on spectrum	2

	analyzer	

Course Outcomes: By the end of this course the students will be able to	
1	Explain the fundamental concepts of wireless communication systems will become clear to the students.
2	Learn cellular system design basics and frequency management techniques.
3	Describe capacity increase mechanisms, interference reduction strategies and long distance propagation concepts.
4	Identify satellite communication system and cell site antenna fundamentals

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Mobile cellular Telecommunications; William, C Y Lee. 2nd Edition McGraw Hill	Latest edition
2	Wireless and Digital communications; Dr. KamiloFeher. 2nd Edition,PHI	Latest edition
3	Wireless communication, principal &practice, T.S Rappaport. 2nd Edition, PHI	Latest edition
4	Digital Satellite Communication,Tri T. Ha. 2nd Edition,McGraw Hill	Latest edition

Course Name	**:**	**EMBEDDED SYSTEMS**
Course Code	**:**	**ECN 305**
Credits	**:**	**4**
L T P	**:**	**3-0-2**

Course Objectives:
At the end of this course, the student should be able to learn concepts of embedded systems, explain Architecture & Programming of 8051 and PIC microcontrollers and its support devices.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO EMBEDDED SYSTEMS:** Fundamentals of embedded system, block diagram and description of each unit	2
2	**8051 MICRO CONTROLLERS:** Architecture, Pin configuration, SFR's , Memory, 8051 Addressing modes, Timers, Interrupts	6
3	**8051 INSTRUCTIONS:** Introduction to 8051 assembly language programming: JUMP, LOOP and CALL instructions, Arithmetic instructions: Unsigned addition and subtraction, unsigned multiplications and Division, signed number concepts and arithmetic operations, Logic And Compare instructions, BCD and ASCII Application Programs.	5
4	**I/O PORT PROGRAMMING:** Single bit instruction programming, Single bit operations with CY, Reading Input Pins Vs Port latch, Programming 8051 timers	5
5	**INTERFACING WITH 8051:** LCD& Keyboard Interfacing , serial communications Programming	4
6	**PIC18FXXXX FAMILY:** Introduction to PIC microcontrollers, Architecture of PIC18 family of devices.	4
7	**PROGRAMMING MODEL:**	3

	PIC18F programming model, instruction set, instruction format. Data copy, arithmetic, branch, logical, bit manipulation and multiply-divide operations. Stacks, subroutines and macros.	
8	**INPUT/OUTPUT PORTS AND INTERFACING:** Concepts of I/O interfacing, PIC18 I/O ports, Interfacing of output and input peripherals.	3
9	**INTERRUPTS AND TIMERS:** Concepts of Interrupts and Timers, Interrupts and their implementation in PIC18, timer operation, Use of Interrupts in applications.	2
10	**CCP MODULE:** Concept of CCP module, Various modes of CCP module and its application.	4
11	**SERIAL I/O:** Concept of serial I/O, PIC18 serial communication module	2
12	**DATA CONVERTERS:** Basic concepts of Data Converters, PIC18F452 A/D and D/A converter modules and its applications.	2

List of Experiments:		**Number of Turns**
1	To get familiar with KEIL and develop at least 10 programs for 8051 Microcontroller	4
2	To get familiar with MPLAB and FLOWCODE software and develop at least 10 programs on each. for PIC Microcontroller	5
3	Using Flowcode, use ZIGBEE, Bluetooth module, GPS module along with PIC Controller	1
4	To interface the various sensors and devices available in the lab with PIC Controller	2
5	Design and developments of at least two applications based on PIC controller.	2

Course Outcomes: By the end of this course, the student will be able to	
1	Learn Architecture &Programming of 8051 and PIC microcontrollers.
2	Design and develop systems based on PIC micro-controller and its interfaces.
3	Design and develop systems based on 8051 micro-controller and its interfaces.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	PIC Microcontroller and Embedded Systems using Assembly and C for PIC18 by M.A. Mazidi, R.D. McKinlay and D. Causey, Pearson	2007
2	The 8051 Microcontroller and Embedded System by- Muhammad Ali Mazidi, Janice Gillespie Mazidi, Pearson Education Publications.	2007
3	Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family), Ramesh GAONKAR, Penram International Publishing	2007 edition
4	Designing with PIC MICROCONTROLLERS By John B Peatman, Pearson Education	2004 reprint

Course Name	**:**	**CONTROL SYSTEMS**
Course Code	**:**	**ECN 401**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to model a control system using different approaches, perform error analysis, analyse the system in time domain and frequency domain and investigate the stability. The student should also be able to design lead, lag, lag lead compensators for the specified requirements, model and analyse the system using state space representation and do block diagram analysis of sampled data control systems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**INTRODUCTION:** Basic components of a control system, classification of control system, Servomechanism, Regulator and process control, Feedback control Systems-Characteristics and Performance	4
2	**MODELLING A CONTROL SYSTEM:** Transfer function approach, Block Diagram Representation, Signal flow graphs, Error Analysis	6
3	**TIME RESPONSE ANALYSIS:** Time response of first order systems, second order systems, steady state errors and error constants, Sensitivity, Concept of Stability, Conditions of Stability ,Root Locus Technique	7
4	**FREQUENCY RESPONSE ANALYSIS:** Correlation between time and frequency response, Polar Plots, Bode Plot, stability margins on Bode plots, Nyquist criteria, Assessment of stability using Nyquist criteria, Design problem, preliminary considerations of classical design, realization of basic compensators, lead compensator, Lag compensator, Lag Lead Compensator	14
5	**CONTROL ACTIONS AND CONTROLLER CHARACTERISTICS:** Proportional, Integral and Derivative Control Actions, Proportional plus integral control action, proportional plus derivative control action, PID controller	3
6	**SAMPLED DATA CONTROL SYSTEMS:** Sample and Hold operations, frequency domain considerations, Transform Analysis of sampled data systems, Linear difference equations, Z-transform, block diagram analysis of sampled data systems,	4
7	**STATE SPACE ANALYSIS OF CONTROL SYSTEMS:** State Space representation, Transfer Matrix, State Transition Matrix, Single Input Single output system, multiple input multiple output system, Controllability and Observability	4

Course Outcomes: By the end of this course, the students will be able to	
1	Determine the transfer function of the system using different approaches.
2	Determine the time response and frequency response of the system and investigate the stability.
3	Design lead, lag, lag lead compensators for the specified requirements.
4	Develop the state space representation of the system and calculate the response to the input.
5	Analyse the sampled data control systems.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Control Systems Engineering By Nagrath and Gopal, New Age International,4th Ed	2006
2	Digital Control Engineering by M Gopal, New Age International	2003
3	Automatic Control Systems, Kuo, B.C, 9th Ed., Wiley India	2009
4	Modern Control Engineering, Ogata, K., 5th Ed., Pearson Education. 2008	2009
5	Modern Control Systems, Dorf, R.C. and Bishop, R.H., 12th Ed., Prentice-Hall of India.	2010
6	Control Systems Engineering, Nise, N. S., 6th Ed., Wiley India	2010

Course Name	**:**	**DIGITAL IMAGE PROCESSING**
Course Code	**:**	**ECN 402**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:

At the end of this course, the students should be able to familiarize with the fundamentals of image processing, transformation techniques, and design & applications of image processing. The students should also be able to provide a useful skill base that would allow them to carry out further study should they be interested and to work in the field.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**FUNDAMENTALS OF IMAGE PROCESSING:** Introduction ,Steps in image processing systems, Image acquisition, Sampling and Quantization , Pixel relationships , Color fundamentals and models, File formats, Image operations, Arithmetic, Geometric and Morphological.	9
2	**IMAGE ENHANCEMENT:** Spatial Domain: Gray level Transformations ,Histogram processing, Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain , DFT, FFT, DCT , Smoothing and sharpening filters – Homomorphic Filtering.	9
3	**IMAGE SEGMENTATION AND FEATURE ANALYSIS:** Detection of Discontinuities, Edge operators, Edge linking and Boundary Detection, Thresholding, Region based segmentation, Morphological Watersheds, Motion Segmentation, Feature Analysis and Extraction.	8
4	**MULTI RESOLUTION ANALYSIS AND COMPRESSIONS:** Multi Resolution Analysis: Image Pyramids, Multi resolution expansion, Wavelet Transforms, Image compression: Fundamentals , Models, Elements of Information Theory , Error free compression , Lossy Compression , Compression Standards.	8
5	**APPLICATION OF IMAGE PROCESSING:** Image classification, Image recognition , Image fusion, Stegenography, Colour Image Processing.pattern recognition.	8

Course Outcomes: By the end of this course, the students will be able to:	
1	Acquire the fundamental concepts of a digital image processing system.
2	Design and implement with Mat lab algorithms for digital image processing.
3	Utilize the skill base necessary to further explore advanced topics of Digital Image Processing.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education	2001
2	Milan Sonka, ValclavHalavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning	1998
3	Anil K. Jain, "Fundamentals of Digital Image Processing". Pearson Education,	1989

Course Name	**:**	**NEURAL NETWORKS AND FUZZY SYSTEMS**
Course Code	**:**	**ECN 403**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, the students should have knowledge of different Neural Networks and solve problems based on pattern classification and recognition. Students should also be able to design various real time applications using the concepts of Fuzzy Logic systems.

Total No. of Lectures – 42

Lecture wise breakup	**Number of**

		Lectures
1	**INTRODUCTION TO NEURAL NET:** Artificial Neural Networks, Biological Neural Networks, Applications of Neural Nets, Architecture of Neural Networks, History of Neural Networks, MC Culloch-Pitt Neuron.	4
2	**PATTERN CLASSIFICATION:** Biases and threshold, Linear separability, Hebbnet, Perceptron, Adaline, Madaline.	4
3	**PATTERN ASSOCIATION:** Training Algorithms for Pattern Association, Heteroassociative Memory Neural Network, Auto associative Net, Iterative Auto associative Net, Bidirectional Associative Memory (BAM).	6
4	**NEURAL NETWORKS BASED ON COMPETITION:** Maxnet, Mexican Hat, Hamming Net, Kohonen Self Organizing Maps, Learning Vector Quantization, Full and Forward Counterpropagation.	6
5	**ADAPTIVE RESONANCE THEORY:** Introduction, Architecture and algorithm of ARTI and ART2.	4
6	**BACKPROPAGATION NEURAL NET:** Standard Back propagation, Architecture, Algorithm, Variations, Derivation of learning rules.	4
7	**FUZZY LOGIC AND SETS:** Concepts of fuzzy logic, Crisp and fuzzy sets, properties of fuzzy sets, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations.	6
8	**FUZZY LOGIC SYSTEM COMPONENTS:** Membership function, features of membership function, fuzzification, membership value assignment, fuzzy decision making, fuzzy system,	4
9	**FUZZY RULE BASED SYSTEM:** Formation of rules, decomposition of rules, aggregation and properties of fuzzy rules, fuzzy interference systems.	4

Course Outcomes: By the end of this course student will be able to:	
1	Describe the concepts of feed forward neural networks.
2	Explain Adaptive neural networks.
3	Design various networks for real time applications.
4	Summarize the concept of fuzziness involved in various systems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Fundamentals of Neural Networks, Laurence Dausett, Pearson Education	2006
2	Neural networks and Fuzzy Logic, K Vinod Kumar,R. Saravana Kumar, Katson Books	2012
3	Neural Networks and machine learning, Haykin, Pearson Education	2008
4	Neural Networks, Satish Kumar, TMH	2012

Course Name	**:**	**ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**
Course Code	**:**	**ECN 404**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the student should become aware of the principle of working of various instruments used to measure basic electronic parameters. The student should be aware of the design features of some of the instruments and transducers. The student should be able to identify and describe basic instrumentation systems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**INTRODUCTION STATISTICAL:** Basic characteristics of measuring devices, types of errors and their statistical analysis, accuracy, precision and ratings of instruments, fundamental, derived and international systems of units and their conversion.	4
2	**ANALOG INSTRUMENTS:** Electromechanical instruments – moving, coil, moving iron, electrodynamics, rectifier, electrostatic instruments, current voltage and power measurements, induction type energy meter, q-meter frequency.	5
3	**TRANSDUCERS:** Actuating mechanisms, electric types of transducers – self generating, piezo electric, photo. Variable parameter transducers – variable resistance strain gauges, variable capacitance – LVDT, magnetos ruction types.	6
4	**OPTOELECTRONIC MEASUREMENTS AND BIOTECHNOLOGY INSTRUMENTS:** Radiometry and photometry, laws of illumination, optical transducers, light modulating techniques, fiber optic sensors, ECG, EEG, cardiovascular measurements, pacemakers, instrumentation for diagnostic x-rays.	7
5	**SIGNAL GENERATORS AND ANALYZERS:** Sweep frequency generator, frequency synthesized signal generator and function generator, wave analyzer harmonic distortion and spectrum analyzer.	6
6	**INDICATING AND RECORDING SYSTEMS:** Digital frequency counters, X-Y and X-T recorders, general purpose oscilloscopes, delayed time base, sampling and digital storage type oscilloscopes, probes	7
7	**DAS AND MICROPROCESSOR BASED INSTRUMENTATION:** Modern Digital DAS Systems, Microprocessor Based Systems like multifunction test instrument, signature analyzer, logic analyzer, temperature monitoring system, water level sensing system, interface standards.	7

Course Outcomes: By the end of this course, the student should be able to:	
1	Operate various electronic instruments required for measuring electronic parameters
2	Troubleshoot the instruments associated.
3	Outline various digital DAS systems and microprocessor Based Systems.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Modern Electronics Instrumentation and Measurement Techniques – Albert D Helfrick, William D Cooper, Pearson Ed	2005
2	Electronic Measurement and Instrumentation by Bernard M. Oliver, J.M. Cage, McGraw Hill	1971
3	Instrumentation, Measurement and Feedback – B Jones	1977
4	Electronic Measurement by Terman and Petizt	2005
5	Biomedical Instrumentation and Measurements – Leslie Cromwell, Weibell, Pfeiffer, second edition,Prentice Hall Mark	2003 (Edition)
6	A Courser in Electrical and Electronic Measurements and Instrumentation – A K Sawney	1996

Course Name	**:**	**ANTENNA AND WAVE PROPAGATION**
Course Code	**:**	**ECN 405**
Credits	**:**	**4**

L T P	**:**	**3 1 0**

Course Objectives:
By the end of this course the students should be able to describe the evolution and basics of antenna and wave propagation technology. Students should also be able to design different type of antennas and analyze antenna's performance.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**BASIC PRINCIPLES AND DEFINITIONS** Retarded vector and scalar potentials. Radiation and induction fields. Radiation from elementary dipole (Hertzian dipole, short dipole, linear current distribution), half wave dipole, Antenna parameters: Radiation resistance, Radiation pattern, Beam width, Gain, Directivity, Effective height, Effective aperture, Bandwidth and Antenna Temperature.	**12**
2	**RADIATING WIRE STRUCTURES AND ANTENNA ARRAYS** Folded dipole, Monopole, Biconical Antenna, Loop Antenna, Helical Antenna. Principle of pattern multiplication, Broadside arrays, Endfire arrays, Array pattern synthesis, Uniform Array, Binomial Array, Chebyshev Array, Antennas for receiving and transmitting TV Signals e.g. Yagi-Uda and Turnstile Antennas.	**10**
3	**APERTURE TYPE ANTENNAS** Radiation from rectangular aperture, E-plane Horns, H-plane Horns, Pyramidal Horn, Lens Antenna, Reflector Antennas. BROADBAND AND FREQUENCY INDEPENDENT ANTENNAS : Broadband Antennas. The frequency independent concept: Rumsey's principle, Frequency independent planar log spiral antenna, Frequency independent conical spiral antenna and Log periodic antenna.	**10**
4	**PROPAGATION OF RADIO WAVES** Different modes of propagation, Ground waves, Space waves, Surface waves and Tropospheric waves, Ionosphere, Wave propagation in the ionosphere, critical frequency, Maximum Usable Frequency (MUF), Skip distance, Virtual height, Radio noise of terrestrial and extraterrestrial origin. Multipath fading of radio waves.	**10**

Course Outcomes: By the end of this course the student will be able to	
1	Analyze a complete radio system comprising of transmitter and receiver with reference to antenna.
2	Quantify the fields radiated by various types of antennas.
3	Design different types of antennas.
4	Analyze antenna measurements to assess antenna's performance.
5	Relate the concept of radio wave propagation.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Antenna & Wave Propagation by Robert E.Collin, McGraw Hill	1985
2	Antennas (2nd Edition) by John D. Kraus, McGraw Hill	1997
3	Electromagnetic Waves and Radiating Systems (2nd Edition) byE.C.Jordan and K.G.Balmain, PHI	1995

Course Name	**:**	**AUDIO & VISUAL SYSTEMS**
Course Code	**:**	**ECN 406**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, student should become aware of the concepts and principles of television. The student should become aware of the concepts of audio devices and various advanced technologies in television.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**FUNDAMENTALS OF TELEVISION** Introduction of television, General concepts-interlaced scanning, Geometric form and aspect ratio, Image continuity, No. of scanning lines, Resolution, Brightness, Contrast, Composite video signal, Television Transmitter, Monochrome television receiver, compatibility between Monochrome and colour television. three color theory, PAL transmitter and receiver.	10
2	**AUDIO DEVICES AND APPLICATIONS** Microphone Sensitivity, Nature of Response and Directional Characteristics, Measurement Microphones, Various Types of Microphones, Various Types of Loudspeakers, Characteristic Impedance of Loud Speakers, Headphone Types, The basics of Magnetic Recording, Sound Cards, Sound Mixers, PA Systems & Installations, Digital Consoles, modern audio recording techniques	8
3	**DIGITAL AUDIO** Digital Audio Fundamentals, review of Sampling and Quantizing, PCM, Audio Compression, Disk-Based Recording, Rotary Head Digital Recorders, Digital Audio Broadcasting, Digital Filtering, Stereophony and Multichannel Sound.	6
4	**DIGITAL VIDEO & STANDARDS** Digitizing Video, Chroma Subsampling, Basics of Video Compression (MPEG-x, H.26x), Digital VTR, Non-Linear Editing, 4:3 Vs 16:9 for Digital Video.	6
5	**ADVANCED TELEVISION CONCEPTS** HDTV, Display Technologies (CRT, LCD, Plasma, LED, Projection), Video Interfaces (Composite, Component, S-Video, DV, SDI, HDMI television DVI),Digtal television, Digital video disc, Flatron picture tube, Video on demand, video on internet, cable television, closed circuit television, Dish TV.	12

Course Outcomes: By the end of this course, the student should be able to:	
1	Explain the concept of television and audio devices.
2	Describe digital audio and video and their standards.
3	Describe various advanced technologies used in TV like LCD, Plasma, LED, Projection.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Modern Television Practice R.R. Gulati, New Age publication	2007, 3rd edition
2	Audio Video Systems R.G. Gupta, - Technical Education ,TMH	2010
3	Essential Guide to Digital Video, John Watkinson, - Snell & Wilcox Inc Publication	1996 ISBN 1 900739 06 2
4	Digital Television Fundamentals Robin, Poulin, McGraw -Hill	2nd Ed,2000
5	Audio Video Systems Principles Practices and Troubleshooting, Bali & Bali, - Khanna Publishing Company.	2010

Course Name	**:**	**TELECOMMUNICATION SYSTEMS**
Course Code	**:**	**ECN 407**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to explain the basic concepts and principles of telecommunication, The students should also be able to describe the concepts of circuit switching, optical fibre communications, line transmission systems, satellite communication systems, public switched telephone networks, digital transmission system standards, network planning and principle of digital switching systems, architecture of CDMA and GSM in telecommunication systems.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO TELECOMMUNICATIONS:** Evolution of telecommunication. Switching system, Strowger switching systems Crossbar switching, Electronic space division switching.	5
2	**SPEECH DIGITALIZATION AND TRANSMISSION:** Sampling, quantization and binary coding, Companding, differential coding, Vocoders, pulse transmission, line coding, time division multiplexing, **TIME DIVISION SWITCHING:** Basic Time Division space switching, Basic Time Division time switching, time multiplexed space switching, time multiplexed time switching, combination switching, three-stage combination switching, n-stage combination switching.	7
3	**OPTICAL FIBER SYSTEMS:** Optical fiber transmission, Radio over fiber, free space optics, telecommunication applications, Synchronous Optical Network (SONET), Wavelength division multiplexing	4
4	**TRAFFIC ENGINEERING:** Network traffic load and parameters, grade of service and blocking probability, modeling switching systems, Incoming traffic and service time characterization, Blocking modes and loss estimates, delay systems	5
5	**TELEPHONE NETWORKS AND DATA NETWORKS:** Subscriber loop systems, switching hierarchy and routing, transmission plan, transmission systems, number plan, charging plan, signaling techniques, In channel signaling, Common Channel signaling, Data transmission in PSTNs, switching techniques for data transmission, data communication architecture, link-to-link layers, end-to-end layers, satellite based networks, local area networks, metropolitan area networks, fiber optic networks, data network standards, protocols stacks, internetworking, IP Telephony	7
6	**INTEGRATED SERVICE DIGITAL NETWORK, MOBILE COMMUNICATION:** Motivation for ISDN, ISDN services, Network and protocol architecture, transmission channels, user network interfaces, signaling, numbering and addressing, service characterization, internetworking, ISDN standards, expert systems in ISDN, broadband ISDN, Voice Data Integration.	5
7	**CDMA:** System Architecture for CDMA. Network and Data Link Layers of CDMA. Signaling Applications in CDMA System. Voice Applications in CDMA System.	5
8	**GSM**: RF Engineering and Facilities Wireless Data, Cellular Communication Fundamentals, GSM Architecture and Interfaces. Radio Link Features in GSM, GSM Logical Channels and Frame Structure. Speech Coding in GSM (Messages, Services and Call Flows in GSM).	4

Course Outcomes: By the end of this course, the students will be able to :	
1	Explain the basic principles of telecommunication systems which includes topics like network switching, optical fiber communication, ISDN, Mobile communication etc.

2	Analyze the concept of speech Digitalization, Telephone networking,data networking etc.
3	Describe the basic architecture of GSM and CDMA in telecommunication.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Telecommunication Switching Systems and Networks by Thiagarajan Viswanathan and Manav Bhatnagar	2015
2	Applications of CDMA in Wireless/Personal Communications by V K Garg, K Smolik	1996

Course Name	**:**	**OPTICAL COMMUNICATION**
Course Code	**:**	**ECN 408**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to name the basic elements of optical fiber transmission link, describe fiber modes and different types of fibers. The student should also be able to summarize the various causes of signal degradation in optical fibers, explain the working of optical amplifiers and important parts at the transmitter (Semiconductor lasers/LEDs, modulators etc) as well as at the receiver sides (optical detector etc.) of the optical communications system, analyze and calculate the link power budget, describe the optical networks (FDDI, SONET/SDH) and operational principles of advanced multiplexing strategies.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**OVERVIEW OF OPTICAL FIBER COMMUNICATIONS:** Block Diagram of Optical Communication System, advantages of optical fiber communication, basic structure of optical fiber waveguide, ray theory transmission, optical fiber modes and configuration, step index & graded index fiber, single mode fiber, multi modifier fiber materials , fiber fabrication.	6
2	**SIGNAL DEGRADATION IN OPTICAL FIBER TRANSMISSION:** Introduction, attenuation, intrinsic & extrinsic absorption losses, linear & nonlinear scattering losses , bending losses , distortion in optical wave guide ,intramodal and intermodal dispersion. Power launching and coupling Source to fiber power launching, power calculation, lensing schemes, fiber to fiber joints, fiber splicing technique, fiber connectors.	6
3	**OPTICAL TRANSMITTERS:** Basic Concepts,Light Emitting Diodes, Semi Conductor Lasers, DFB Lasers, Coupled Cavity semiconductor Lasers, Tunable Semiconductor Lasers, Vertical Cavity Semiconductor Lasers, Laser Characteristics, Transmitter design.	6
4	**OPTICAL RECEIVERS:** Basic concepts, p-n Photo Diodes, p-i-n Photo Diodes, Avalanche Photo Diode, MSM Photo detector, Receiver Design, Receiver Noise; Noise mechanism, Receiver sensitivity; Bit error rate, Minimum Receiver Power, Sensitivity Degradation, Receiver Performance	5
5	**OPTICAL COMMUNICATION SYSTEM DESIGN:** Point to point links, system considerations, link power budget, rise time budget.	3
6	**NONLINEAR EFFECTS IN FIBER OPTIC LINKS:** Concept of self-phase modulation, cross phase modulation, Raman scattering, Brillouin scattering ,four wave mixing, group velocity dispersion and solution based communication , wavelength converters	4
7	**OPTICAL AMPLIFIERS:**	4

	Semiconductor optical amplifiers, EDFA, Raman amplifier.	
8	**OPTICAL NETWORKS:** Optical multiplexing techniques-WDM, DWDM, CWDM & CDMA, Network Topologies, FDDI Networks: - Frame and Token formats, Network operation, SONET/SDH, SONET frame structure, SONET layers, operational principles of WDM - Broadcast and Select WDM networks, Single hop networks, Wavelength routed networks, Introduction to Optical Computing & Photonics.	6

Course Outcomes: By the end of this course, the students will be able to	
1	Classify the structures of Optical fiber and types.
2	Discuss the channel impairments like losses and dispersion.
3	Classify the Optical sources and detectors and to discuss their principle.
4	Perform fiber-optic communication system engineering calculations, identify system tradeoffs, and apply this knowledge to modern fiber optic systems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Optical Fiber Communication, McGraw -Hill ,3rdEditionl,byGerd Keiser	2006
2	Fiber Optic Communication Systems by G.P. Agrawal, (4/e), Wiley, 2002.	2010
3	Optical Networks A practical perspective by Rajiv Ramaswami, Kumar N. Sivaranjan, 3rd edition, Elsevier,	2009
4	Fiber-Optic Communications Technology by .Djafar K. Mynbaev, Lowell L. Scheiner, Pearson Education	2000
5	Optical Fiber Communications, Principles and Practice, Senior, PHI – 2nd Edition.	2001

Course Name	**:**	**ADVANCED DIGITAL COMMUNICATION**
Course Code	**:**	**ECN 409**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
By the end of this course the students should be able to understand the advanced digital communication techniques and the concepts of modulation and multiple access techniques with their applications. Students should be able to understand signals, systems, and analysis methods for digital communications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CHARACTERIZATION OF COMMUNICATION SIGNALS AND SYSTEMS** Representation of Band pass Signals and Systems ,Representation of Linear Band pass Systems ,Response of a Band pass System to a Band pass Signal ,Representation of Band pass Stationary Stochastic Processes, Signal Space Representation ,Signal Space Concepts , Memory less Modulation Methods, Spectral Characteristics of Digitally Modulated Signals ,Power Spectra of Linearly Modulated Signals.	**10**
2	**OPTIMUM RECEIVERS FOR THE ADDITIVE WHITE GAUSSIAN NOISE CHANNEL** Optimum Receiver for Signals Corrupted by AWGN ,Correlation Demodulator ,Matched-Filter Demodulator, Performance of the Optimum Receiver for Memory less ,Modulation ,Probability of Error for Binary Modulation , Probability of Error for M-ary Orthogonal Signals , Probability of Error for Simplex Signals, Probability of Error for M-ary Binary-Coded Signals ,Differential PSK (DPSK) and its Performance, Comparison of Digital	**12**

	Modulation Methods , Optimum Receiver for CPM Signals, Optimum Demodulation and Detection of CPM, Optimum Receiver for Signals with Random Phase in AWGN Channel.	
3	**SYNCHRONIZATION** Timing and Frequency Offset in OFDM, Synchronization & System Architecture, Timing and Frame Synchronization, Frequency Offset Estimation, Phase Noise Channel Estimation and Equalization, Introduction, Channel Estimation, Coherent Detection, Block-Type Pilot Arrangement, Comb-Type Pilot Arrangement, Non-coherent Detection, Performance, Channel Estimation for MIMO-OFDM.	**10**
4	**EQUALIZATION AND MULTIPLE ACCESS TECHNIQUES** Equalization, Time Domain Equalization, Equalization in DMT, Delay Parameter, Frequency Domain Equalization, Echo Cancellation, OFDM based Multiple Access Techniques, FDM/ Multiple Access, TDM/ Multiple Access, CDMA, Space Division and Polarization- division Multiple Access, Multiple Access Information flow, ALOHA.	**10**

Course Outcomes: By the end of this course the student will be able to	
1	Explain modern digital communications theory and systems.
2	Emphasize on modern digital data transmission concepts and optimization of receivers.
3	Gain expertise with signals, systems, and analysis methods for digital communications
4	Explain various equalization and multiple access techniques used in digital communication.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital communications (4th Edition) by J. Proakis,MGH	2001
2	Digital Communications Fundamentals and Applications (2nd Edition) by Bernard Sklar, Pearson Education.	2001
3	Multi-carrier Digital Communications:TheoryandApplications of OFDM (2nd Edition) by A. R. S. Bahai, B. R. Saltzberg, M.Ergen, Springer	2004
4	Digital Communication (3rdEdition) by Edward A Lee & David G Messerschmitt, Kluwer Academic Publishers	2003
5	Modern Wireless Communications by Simon Haykin and Michael Moher, Person	2004

Course Name	**:**	**SATELLITE COMMUNICATION**
Course Code	**:**	**ECN 410**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

By the end of this course the students should be able to explain satellite communication mechanics. Student should also be able to identify the modulation and multiplexing techniques required for satellite communication and be able to design the power budget for satellite links.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION** Origin and brief history of satellite communications, an overview of satellite system engineering, satellite frequency bands for communication. Orbital theory: Orbital mechanics, locating the satellite in the orbit w.r.t. earth look angle determination. Azimuth & elevation calculations.	**10**
2	**ENCODING & FEC FOR DIGITAL SATELLITE LINKS** Channel capacity, error detection coding, linear block, binary cyclic codes, and convolution	**8**

	codes. Satellite Systems: Satellite Earth station Technology, satellite mobile communication, VSAT technology, Direct Broadcast by satellite (DBS).	
3	**SPACECRAFT SYSTEMS** Attitude and orbit control system, telemetry, tracking and command (TT&C), communications subsystems, transponders, spacecraft antennas. Satellite link design: Basic transmission theory, noise figure and noise temperature, C/N ratio, satellite down link design, satellite uplink design.	**8**
4	**MODULATION, MULTIPLEXING, MULTIPLE ACCESS TECHNIQUES** Analog telephone transmission, Fm theory, FM Detector theory, analog TV transmission, S/N ratio Calculation for satellite TV linking, Digital transmission, base band and band pass transmission of digital data, BPSK, QPSK, FDM, TDM, Access techniques: FDMA, TDMA, CDMA.	**8**
5	**ENCODING & FEC FOR DIGITAL SATELLITE LINKS** Channel capacity, error detection coding, linear block, binary cyclic codes, and convolution codes. Satellite Systems: Satellite Earth station Technology, satellite mobile communication, VSAT technology, Direct Broadcast by satellite (DBS).	**8**

Course Outcomes: By the end of this course the student will be able to	
1	Identify the communication satellite mechanics
2	Explain the satellite internal sub systems for communication applications
3	Design the power budget for satellite links
4	Describe various constellations of satellite and their applications

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Satellite communication (2nd Edition) by Timothy Pratt, Charles W. Bostian, John Wiley & Sons Publication	2003
2	Satellite Communications Systems Engineering (2nd Edition) by Wilbur Pritchard, Henri Suyderhoud, Pearson Education	2007
3	Digital Communication by satellite by J.J. Spilker, PHI Publication	1997
4	Communication satellite systems by J. Martin, PHI publication	2001

Course Name	**:**	**HDL BASED SYSTEM DESIGN**
Course Code	**:**	**ECN 411**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to demonstratethe designing of asynchronous logic design and FSMs, identify and define the syntax and various constructs of VHDL language and programming using VHDL. The student should also be able to design the digital logic using various programmable logic devices.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**FINITE STATE MACHINES:** Introduction to Synchronous Sequential Circuits, Asynchronous Sequential Circuits, The Finite State Model, Memory Elements and Their Excitation Functions, Analysis and Synthesis of Synchronous Sequential Circuits, Computing Machine. Flow tables, Analysis and Synthesis, Races and Cycles, hazards in asynchronous circuits	6
2	**BASIC VHDL ELEMENTS:**	3

	Identifiers, Data Objects, Data Types, Operators.	
3	**MODELING:** Behavioral modeling: Entity declaration, architecture body, Various Sequential Statements and Constructs, multiple processes, postponed processes. Dataflow Modeling: Concurrent Signal Assignment Statements, delta delay model, multiple drivers, block statement, concurrent assertion statement. Structural Modeling: Component Declaration, component Instantiation, resolving signal values.	10
4	**SUPPORTING CONSTRUCTS:** Generics and Configuration, Subprograms and Overloading, Operator overloading, Package declaration, package body, design Libraries, visibility	8
5	**ADVANCED FEATURES:** Generate statements, qualified expressions, type conversions, guarded signals, attributes, aggregate targets.	7
6	**MODEL SIMULATION:** Writing a Test Bench, Simulation, Use of text file for input and output, Hardware Modeling Examples, Modeling and Simulation of Moore and Mealy FSMs.	4
7	**PROGRAMMABLE LOGIC DEVICES (PLD) AND FIELD PROGRAMMABLE GATE ARRAYS (FPGA):** Basic Concepts, Architecture and Usage. Combinational and sequential Logic Design with PLDs/FPGAs	4

Course Outcomes: By the end of this course, the students will be able to	
1	Design asynchronous digital circuits.
2	Identify and code the digital modules using different VHDL modeling styles.
3	Construct the digital logic circuit by using subprograms and other supporting constructs in VHDL language.
4	Demonstrate the use of test benches in designing of digital circuits using VHDL.
5	Create the designed circuits on various programmable logic devices.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	VHDL: Analysis and modeling digital systems, by Z Navabi, McHill, 2nd edition	1998
2	VHDL Primer, J Bhaskar, Prentice Hall, 3rd Edition	2000
3	VHDL: A Logic Synthesis Approach by D. Naylor, and S. Jones, Springer	1995
4	VHDL for Logic Synthesis by A. Rushton, Wiley 2nd Ed.	1998

Course Name	**:**	**MEMS AND MICROSYSTEMS**
Course Code	**:**	**ECN 412**
Credits	**:**	**4**
L T P	**:**	**3 10**

Course Objectives:
By the end of this course students should be able to explain the evolution, basics of MEMS and microsystems technology, summarize the basic concepts and design methodology of mems and Microsystems for various applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**OVERVIEW OF MEMS AND MICROSYSTEMS** Introduction Microsystem vs. MEMS, Microsystems and Microelectronics, the	**12**

	Multidisciplinary Nature of Microsystem design and manufacture, Application of MEMS in various industries. MEMS and Miniaturization: Scaling laws in miniaturization: Introduction to Scaling, Scaling in: Geometry, Rigid Body dynamics, Electrostatic forces, Electromagnetic forces, Electricity, Fluid Mechanics, Heat Transfer. Materials for MEMS and Microsystems – Si as substrate material, mechanical properties of Silicon, Silicon Compounds (SiO2, Si3N4, SiC, polySi, Silicon), Piezoresistors, GaAs, Piezoelectric crystals, Polymers, Packaging Materials.	
2	**MICROMACHINING PROCESSES** Overview of microelectronic fabrication processes used in MEMS, Bulk Micromachining – Isotropic & Anisotropic Etching, Comparison of Wet vs Dry etching, Surface Micromachining –General description, Processing in general, Mechanical Problems associated with Surface Micromachining, Introduction to LIGA process, Introduction to Bonding. Assembly of 3D MEMS - foundary process.	**10**
3	**MICROSYSTEMS & MEMS DESIGN** Design Considerations: Design constraints, Selection of Materials, Selection of Manufacturing processes, Selection of Signal Transduction, Electromechanical system, packaging. Process design, Mechanical Design – Thermo mechanical loading, Thermo mechanical Stress Analysis, Dynamic Analysis, Interfacial fracture Analysis, Mechanical Design using Finite Element Method.	**10**
4	**DESIGN CASE USING CAD. PRINCIPLES OF MEASURING MECHANICAL QUANTITIES** Transduction from Deformation of Semiconductor Strain gauges: Piezo resistive effect in Single Crystal Silicon, Piezo resistive effect in Poly silicon Thin films, Transduction from deformation of Resistance. Capacitive Transduction: Electro mechanics, Diaphragm pressure sensors. Structure and Operation of Accelerometers, Resonant Sensors, Thermal Sensing and actuation.	**10**

Course Outcomes: By the end of the course, the student must be able to:	
1	Explain the operation principles of advanced micro- and nanosystems.
2	Describe the technology to fabricate advanced micro- and nanosystems.
3	Apply a concept of a micro- and nano-device into a real device considering the scaling laws and boundary conditions involved.
4	Present the basics of implementation of MEMS into products.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Microsystem Design (5thEdition) by Stephen D. Senturia, Kluwer Academic Publishers	2003
2	Micro Technology and MEMS by M. Elwenspoek and R. Wiegerink, Springer,	2000
3	Fundamentals of Microfabrication and Nanotechnology (3rdEdition) by Marc Madou, CRC Press	2011
4	MEMS & Microsystems: Design, Manufacture, and Nanoscale Engineering (2ndEdition)by Tai-Ran H Su, Tata Mcgraw.	2008

Course Name	**:**	**NANO TECHNOLOGY**
Course Code	**:**	**ECN 413**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

By the end of this course students should be able to describe the evolution and basics of nano technology, explain the various synthesis and nanofabrication process and their applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO NANOTECHNOLOGY AND NANO MATERIALS** History, ethical issues, applications in different fields, bottom up and top down approaches, Introduction to Zero, One and Two Dimensional Nanostructures, Quantum devices: Resonant tunneling diode, Coulomb Blockade, Single Electron Transistor.	**12**
2	**NANOMATERIAL SYNTHESIS TECHNIQUES** Physical methods: ball milling, Atomic Layer Deposition, Molecular beam epitaxy, spray pyrolysis, Chemical Methods: Sol gel, self-assembly, Chemical Vapor depositions, template manufacturing.	**10**
3	**NANO-FABRICATION** High resolution nano lithography, E-beam and nano imprint lithography, Dip-Pen lithography, AFM Lithography. Nano characterization: High Resolution TEM, Scanning Probe Microscopes: Atomic Force Microscope and Scanning Tunneling Microscope, Nano manipulator, Lab on a Chip concept.	**8**
4	**APPLICATIONS** Carbon nanotubes, structures and synthesis, growth mechanism and properties, devices applications, Nanowires: synthesis and characterization, Molecular Switches and logic gates.	**12**

Course Outcomes:	
1	Outline the importance of nano dimensional materials and their applications.
2	Realize and explain that the growth of nano-materials.
3	Characterize and study the properties of material
4	Demonstrate the applications of nano electronic devices and understand their basic principles.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Nanotechnology: Principles and Practices by Sulbha Kulkarni,Capital Publishing	2011
2	Hand book of Nanotechnology (3rd Edition) by Bhushan, Springer	2007
3	Nano: The Essentials: Understanding Nanoscience and Nanotechnology by T. Pradeep,McGraw Hill Professional	2008
4	Fundamentals of Microfabrication and Nanotechnology (3rdEdition) by Marc Madou, CRC Press	2011

Course Name	**:**	**FPGA BASED SYSTEM DESIGN**
Course Code	**:**	**ECN 414**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, students should have the knowledge of digital design techniques using field programmable gate arrays (FPGAs), FPGA architecture, digital design flow using FPGAs, and other technologies associated with field programmable gate arrays.

Total No. of Lectures – 42

Lecture wise breakup	**Number of**

		Lectures
1	**REVISION OF BASIC DIGITAL SYSTEMS:** Combinational Circuits, Sequential Circuits, Timing, Electrical Characteristics, Power Dissipation.	4
2	**REVIEW OF VHDL:** Introduction, Behavioral, Data flow, Structural Models, Simulation Cycles, Process, Concurrent Statements, Sequential Statements, Operator overloading Loops, Delay Models, Sequential Circuits, FSM Coding, Library, Packages, simulation	12
3	**PROGRAMMABLE LOGIC DEVICES:** Introduction, Evolution, PROM, PLA, PAL, Applications, Design Flow, Programmable Interconnections.	6
4	**FUNDAMENTALS OF FPGA:** The key things about FPGA, fusible link technologies, antifuse technologies, SRAM based technology, EPROM, EEPROM, Flash based technologies.	4
5	**FPGA ARCHITECTURE:** Fine, medium grained, coarse grained, MUX and LUT based design, embedded RAM.	4
6	**PROGRAMMING FPGA:** Configuration files, configuration ports, JTAG in brief, programming using JTAG port.	4
7	**DESIGN TOOLS:** Design Flow, Xilinx Virtex (Architecture), tools for simulation, Case Studies based on designing and synthesis of various digital systems.	8

Course Outcomes: By the end of this course student will be able to:	
1	Explain various FPGA architectures.
2	Design Digital circuits using field programmable gate arrays.
3	Identify Various Design Tools.
4	Explain various Programmable Logic Devices.
5	

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	'Design warriors guide to FPGA' by Clive Max, Elsevire.	2004
2	'Circuit design with VHDL' by Voleni A Pedroni, MIT Press.	2011
3	'Modern VLSI' design by Wayen Wolf, Prentice Hall	2008
4	'Digital design Principles and Practices' by John F. Wakerly, Prentice hall	2006

Course Name	**:**	**CMOS ANALOG VLSI DESIGN**
Course Code	**:**	**ECN 415**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the student should become aware of device modeling, various types of analog systems, CMOS amplifiers and op Amps. The students shall become familiarize with various analysis and simulation techniques.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION:**	6

	Basics of CMOS, CMOS Capabilities and Limitations and CMOS Transistors and Logic. Analog IC Design and Analog Signal Processing. Overview of the VLSI technologies, VLSI Circuits and Analog IC Design Fundamentals. CMOS Technology- Basic MOS Semiconductor Fabrication Processes, pn junction, MOS Transistor, Other Considerations of CMOS Technology, Integrated Circuit Layout.	
2	**CMOS DEVICE MODELLING:** Simple MOSLarge-Signal Model, Other MOS Large-Signal Model Parameters, Small Signal Model for MOS Transistor, Subthreshold MOS Model, Measurement of MOSFET Parameters- Diode Models: DC- Small Signal and High Frequency Model, DC Small Signal and High Frequency BJT Model- Measurement of BJT Model Parameters.	6
3	**VLSI CIRCUIT DESIGN**: VLSI Circuits Design Theory, Process overview, Transistor device model, Circuit characterization. Technology libraries Overview. Pre-layout parasitics estimation. Post layout simulation techniques. VLSI Circuit Schematics and Simulation EDA Tool Flow.	6
4	**ANALOG IC DESIGN:** Analog IC Design Theory,Analog IC (CMOS) Detailed Design Flow, Active/Passive devices for Analog VLSI Design. Analog CMOS Subcircuits: MOS Switch, MOS Diode/Active Resistor, Current Sinks and Sources, Current Mirrors, Current and Voltage References, Bandgap Reference.	7
5	**CMOS AMPLIFIERS:** Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High-Gain Amplifier Architectures.	5
6	**CMOS OPERATIONAL AMPLIFIERS:** Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps and their Power Supply Rejection Ratio, Cascode Op Amps, Buffered Op Amps, High Speed/Frequency Op Amps, Differential Output Op Amps, Micro power Op Amps, Low Noise Op Amps, Low Voltage Op Amps.	8
7	**ANALYSIS AND SIMULATION TECHNIQUES:** Different types of Analysis and Simulation techniques, Analog IC Schematics and Simulation EDA.	4

Course Outcomes: By the end of this course, the students will be able to	
1	Explain the concepts of analog design.
2	Design various analog systems including CMOS amplifiers, op Amps, and switched capacitor circuits.
3	Describe different types of Analysis and Simulation techniques.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Allen, Phillip E. & Holberg, Douglas R. “CMOS Analog Circuit Design” Oxford University Press	2002
2	Kang S.M, Leblebici Y,"CMOS Digital Integrated Circuits : Analysis and Design" Tata McGraw Hill, 3rd ed.	2006
3	J. Baker “CMOS: Circuit Design, Layout, and Simulation” 2nd Edition,Wiley IEEE Press	2007
4	B. Razavi, “Design of Analog CMOS Integrated Circuits ” McGraw Hill	2004
5	Neil H. E. Weste, Kamran Eshraghian “ Principles of CMOS VLSI Design ”2nd edition , Pearson Education India	1999
6	Michael J S Smith “Application-Specific Integrated Circuits” Addison-Wesley Professional	1997

Course Name	**:**	**FOUNDATIONS OF VLSI CAD**
Course Code	**:**	**ECN 416**
Credits	**:**	**4**

L T P	:	3-1-0

Course Objectives:
By the end of this course students should be able to explain the fundamentals of computer aided design tools for the modeling, design, analysis, test and verify digital VLSI systems. This course may also help the students to develop the algorithms as well as the working of the VLSI CAD software.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**LOGIC DESIGN ALGORITHMS:** SOP, POS minimization, Petrick's Method, Branch and Bound method, Dynamic Programming, Divide-Conquer, Greedy Algorithm based approach, Binary Design Diagram. Set covering problem solutions like Quine-McCluskey Algorithm, Iterated Consensus Method	7
2	**INTRODUCTION TO VLSI PHYSICAL DESIGN AND LAYOUT COMPACTION:** Introduction to VLSI Physical Design: Physical Design Automation, VLSI Design Cycle, New Trends in VLSI Design Cycle, Design Styles. VLSI Physical Design Automation: Physical Design, Physical Design Cycle, VLSI Design Automation. Layout Compaction: Design Rules, Symbolic Layout, Problem Formulation, Applications of Compaction, Informal Problem Formulation, Graph Theoretical Formulation, Maximum Distance Constants. Algorithms for Constant Graph Compaction: A Longest Path Algorithm for DAGs, The Longest Path in Graphs with Cycles, The Bellman-Ford Algorithm, Discussion: Shortest Paths, Longest Paths and Time Complexity	10
3	**PLACEMENT, PARTIONING & FLOOR PLANNING:** Placement and Partitioning: Circuit Representation, Wire-length Estimation, Types of Placement Problems, Placement at Various Levels, Design-Style specific Placement, Placement Algorithms: Constructive Placement, Iterative Improvement. Partitioning: Circuit Partitioning, Hierarchical Partitioning, Partition Levels, Problem Formulation, Classification of Partitioning Algorithms, The Kernighan-Lin Partitioning Algorithms Floor Planning: Floor-planning Concepts, Terminology and Floor-plan Representation, Hierarchical Design, Dead Spaces, Design-Style Specific Floor Planning Optimization Problems in Floor Planning, Slicing and Non-Slicing Floor-plans Shape Functions and Floor-plan Sizing	10
4	**ROUTING:** Types of Local Routing Problems, Area Routing, Channel Routing: Channel Routing Models, The Vertical Constant Graph, Horizontal Constants and the Left-edge Algorithm, Channel Routing Algorithms, Global Routing: Standard-cell Layout, Building-block Layout and Channel Ordering, Algorithms for Global Routing: Taxonomy of VLSI Routers, Design-Style Specific Routing	7
5	**HIGH LEVEL SYNTHESIS:** Data flow Graphs, Hardware Optimization, Task Scheduling, Technology Mapping	8

Course Outcomes: By the end of this course the students will be able to	
1	Establish comprehensive understanding of the various phases of CAD for digital electronic systems,
2	Simulate digital logic to physical design, including test and verification.
3	Demonstrate knowledge and understanding of fundamental concepts in CAD and to establish capability for CAD tool development and enhancement.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	K. Hoffman and R.E. Kunze, Linear Algebra, Prentice Hall (India)	1986
2	Logic Synthesis and Verification by Gary. Hatchel	Latest

		edition
3	S.H. Gerez, "Algorithm for VLSI Design Automation", John Wiley & Sons	2002
4	N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers	2002

Course Name	**:**	**ADVANCED MICROPROCESSOR**
Course Code	**:**	**ECN 421**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, students should be able to understand architecture and related applications of 80286, 80386, 80486 processors. Students should also have knowledge about latest Pentium microprocessors and system buses.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**80286, 80386 AND 80486 MICROPROCESSORS** 80286 - Architecture, Real and Virtual Addressing Mode Instruction set, Interrupts, 80386- Architecture, Special Registers, Memory Management, Memory Paging Mechanism, 80486- Architecture ,Enhancements , Cache Memory, Exception Handling, Comparison of Microprocessors	20
2	**Bus Interface and System Buses** Bus Interface- ISA- EISA- VESA- PCI- PCIX, SPI,USB ,RS 232	8
3	**I/O PGROGRAMMING** Fundamental I/O consideration, programmed I/O, Interrupt I/O, DMA technique	5
4	**PENTIUM MICROPROCESSORS** Pentium Microprocessor Architecture – Special Pentium Registers, Pentium Memory Management, Salient features of Pentium4, introduction to MMX.	6
5	**INTRODUCTION TO LATEST PROCESSORS** i5, i7, Core2Duo, Quadcore.	3

Course Outcomes: By the end of this course student will be able to:	
1	Analyze the architecture of Intel Pentium processors and introduction to some latest processors.
2	Explain various system buses and their interface.
3	Describe the detailed architecture and importance of 80X86 processors

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Advanced Microprocessors & peripherals by A K Ray & K M Bhurchandi, TMH Publication.	Latest edition
2	John Paul Shen, Mikko H.Lipasti, "Modern Processor Design", Tata McGraw Hill,	Latest edition
3	The Intel Microprocessor by Barry B. Brey, PHI Publication	2012
4	Microprocessor & Interfacing by Douglas V Hall, TMH Publication	2009

Course Name	**:**	**ADVANCED DIGITAL SIGNAL PROCESSING**

Course Code	**:**	**ECN-422**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, students will be able to learn advanced transformation techniques, explain design & implementation of FIR and IIR digital filters using various techniques. The student should be able to describe multirate signal processing and explain features and architecture of DSP processors.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**DESIGN OF DIGITAL FILTERS:** **IIR FILTER:** Digital filter design techniques: Impulse invariance. Bilinear transformation, Butterworth filter design technique, Frequency transformation techniques, Filter design based problems. **FIR FILTERS:** FIR filter design using Window technique, Frequency sampling, technique, optimization algorithms. FIR Filter design problems.	10
2	**MULTI-RATE SIGNAL PROCESSING:** Integer sampling rate conversion. Interpolation and decimation, Sampling rate conversion by an arbitrary factor, Applications of multi-rate signal processing.	5
3	**WAVELET TRANSFORM:** Continuous & discrete wavelet transforms, Filter Banks. Multi resolution analysis.	5
4	**EFFECTS OF FINITE WORD LENGTH IN DSP SYSTEMS:** Rounding and truncation errors, quantization effects in A/D converter, FIR and IIR filters.	2
5	**DIGITAL SIGNAL PROCESSOR :** Fixed point and floating point processors, Basic Architecture of DSP Processor Computational building blocks, MAC unit, Bus Architecture, memory, Addressing Modes, Parallelism and pipelining, Parallel I/O interface, Interrupts, DMA.	10
6	**APPLICATIONS OF DSP:** Speech processing, Image Processing, Linear prediction coding technique, Discrete Kalman filter.	6
7	**ADAPTIVE FILTERS:** Introduction to Adaptive filters, adaptive filters as noise cancellers, adaptive line enhancer, in-system modeling Basic Wiener filter.	4

Course Outcomes: By the end of this course student will be able to:	
1	Design and develop systems based on digital filters, multirate signal processing systems using simulation tools.
2	Acquire the concepts of digital signal processor
3	Implement DWT based technique using simulation tools.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Digital Signal Processing-A.V. Oppenheim & B.W. Jervis; PHI.	2006
2	Digital Signal Processing-J.G. Proakis& D.G. Manolakis; PHI	2006
3	Digital Signal Processing—M.H. Hayes; Schaum's Outlines.	2002
4	Digital Signal Processing-S Salivahanan, A Vallavraj& C Gyanapriya; TMH.	2011

Course Name	**:**	**INFORMATION THEORY AND CODING**

Course Code	**:**	**ECN 423**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to explain the principles and applications of information theory in digital communication systems, calculation of the capacity of a communication channel in noiseless and noisy channels. Students should also be able to explain different coding scheme.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION :** Overview of Shannon's contributions to Information Theory and the digital communication system.	2
2	**MODULATION & DETECTION :** Digital modulation: Modulation classification, Signal space representation & the symbol constellation, Linear memory less modulation scheme examples Optimum detection: Correlation demodulator & matched filter, Optimum symbol detectors, Detector performance for several modulation schemes.	5
3	**SOURCE CODING** : Lossless coding for discrete-valued sources, Discrete memory less source (DMS) Discrete stationary source, Lossy coding for discrete-time sources.	4
4	**CHANNEL CAPACITY & INTRODUCTION TO CHANNEL CODING:** Channel models, Channel capacity, The noisy channel coding theorem.	2
5	**BLOCK CODES**: Introduction to block codes, A Galios field primer, Linear block codes, Initial comments on Performance & implementation, Important binary linear block codes, Binary linear block code decoding & performance analysis, Non-binary block codes - Reed-Solomon (RS) codes, Techniques for constructing more complex block codes: product codes, interleaving, concatenated block codes, Space-time block codes.	9
6	**CONVOLUTIONAL CODES:** Linear convolutional codes & their descriptions, Transfer function representation & distance properties, Decoding convolutional codes, Soft-decision MLSE, Hard-decision MLSE, The Viterbi algorithm for MLSE, Performance of convolutional code decoders, Viterbi algorithm implementation issues: RSSE, trellis truncation, cost normalization, Sequential decoding: Stack, Fano, feedback decision decoding, Techniques for constructing more complex convolutional codes.	8
7	**TURBO & LOW DENSITY PARITY CHECK (LDPC) CODES:** Decoding algorithms which generate extrinsic information Turbo codes, Turbo product codes, Turbo equalization, Low Density Parity Check (LDPC) coding & decoding-Basic graph theory concepts, Graph representation of LDPC codes, Decoding LDPC codes.	8
8	**TRELLIS CODED MODULATION (TCM)**: Introduction, Trellis coding with higher order modulation, Set partitioning, Trellis coded modulation (TCM),TCM decoding and performance.	4

Course Outcomes: By the end of this course, the students will be able to:	
1	Describe the concepts of information theory and digital communication.
2	Construct efficient codes for data on imperfect communication channels.
3	Explain the concepts of coding schemes.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**

1	Digital Communications, by John Proakis & MasoudSalehi, 5th edition, McGraw-Hill,	2008
2	Digital Communication by Amitabha Bhattacharya, TMH	2006

Course Name	**:**	**LOW POWER VLSI DESIGN**
Course Code	**:**	**ECN-424**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
The objective of this course is to familiarize the students with sources of power in an IC. Identify the power reduction techniques and to introduce with the Device & Technology Impact on Low Power.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**LOW POWER BASICS:** Need for low power VLSI chips, Dynamic Power Dissipation, Short Circuit Power, Switching Power, Gliching Power, Static Power Dissipation. Emerging Low power approaches. Physics of power dissipation in CMOS devices. Silicon-on-Insulator**.**	8
2	**DEVICE & TECHNOLOGY IMPACT ON LOW POWER:** Dynamic dissipation in CMOS, Transistor sizing & gate oxide thickness, Impact of technology Scaling, Technology & Device innovation.	8
3	**LOW-POWER DESIGN APPROACHES:** Leakage Power minimization Approaches:Variable-threshold-voltage CMOS (VTCMOS) approach, Multi-threshold-voltage CMOS (MTCMOS) approach. **ARCHITECTURAL LEVEL APPROACH**: Pipelining and Parallel Processing Approaches. **SWITCHED CAPACITANCE MINIMIZATION APPROACHES:** System Level Measures, Circuit Level Measures.	14
4	**ARITHMETIC COMPONENTS AND POWER ESTIMATION:** Low power arithmetic components: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look- Ahead Adders. **POWER ESTIMATION TECHNIQUES**: Logic power estimation – Simulation power analysis Probabilistic power analysis.	12

Course Outcomes: By the end of this course, the students will be able to:	
1	Demonstrate the sources of power dissipation in an IC in various applications.
2	Summarize the power reduction techniques.
3	Explain various power estimation techniques.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Kaushik Roy, Sharat C. Prasad, "Low power CMOS VLSI circuit design", Wiley Inter science Publications"	1987
2	Practical Low Power Digital VLSI Design – Gary K. Yeap, Kluwer Academic Press	2002
3	Low Power CMOS VLSI Circuit Design – A. Bellamour, M. I. Elamasri, Kluwer Academic Press	1995

Course Name	**:**	**PROBABILITY AND RANDOM PROCESS**
Course Code	**:**	**ECN 425**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to describe basic concepts in random processes, explain the applications of random phenomena and understand the concepts of pattern recognition, voice and image processing and filtering theory.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**STOCHASTIC PROCESS:** General Concepts – Defn, Systems with stochastic inputs, the power spectrum, Discrete time processes	9
2	**SPECTRAL REPRESENTATION:** Factorization, finite-order systems and state variables, Fourier Series and expansions, spectral representation of random process	9
3	**SPECTRUM ESTIMATION:** Ergodiety, Spectrum estimation, extrapolation, and system identification, the general class of extrapolating spectra and Tula's parameterization	8
4	**MEAN SQUARE ERROR ESTIMATION:** Introduction, Predictor, Filtering and prediction, Kalman filters	8
5	**ENTROPY:** Introduction, Basic Concepts, Random Variables and stochastic process, the maximum entropy method, coding, channel capacity	8

Course Outcomes: By the end of this course, the students will be able to	
1	Describe basic probability concepts
2	Identify and compare standard distributions which can describe real word phenomena
3	Solve the functions of random variable with more than one random variable.
4	Understand and characterize phenomena which evolve with respect to time in probabilistic manner.
5	Analyse the response of random inputs to linear time invariant systems

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, First Indian Reprint(2007)	2007
2	Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", TMH, 4th edition, New Delhi, 2002	2002

Course Name	**:**	**ANALOG AND DIGITAL ELECTRONICS**
Course Code	**:**	**ECN 431**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the student should be able to identify active and passive components and to solve simple electronic circuits. The student should also be able to explain construction, operation, characteristics and biasing of

diodes, transistors, FETs and applications of operational amplifier. The student should be able to demonstrate the ability to use logic gates, Basic Boolean laws, minimization techniques for the designing of various combinational circuits. The student should also be able to describe operation, characteristic equations, excitation table of various flip flops and explain the conversion of flip flops.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CIRCUIT THEORY FUNDAMENTALS** Electrical quantities, Electrical components, Circuit laws and theorems, Circuit analysis, Measurement equipment	4
2	**DIODES AND DIODE CIRCUITS** Diode, Diode models, Rectifier circuits, Clippers, Clampers,	4
3	**BIPOLAR JUNCTION TRANSISTORS** Junction transistor, Regions of operation, Transistor configurations, Current components in a transistor, Transistor as an amplifier, characteristics of CB, CE and CC configuration, Frequency Response of single stage CE amplifier, introduction to feedback amplifiers and oscillators	7
4	**FIELD EFFECT TRANSISTORS:** Introduction, FET Construction, types of FET, Characteristics of FETs, MOSFET: types and working principle.	4
5	**OPERATIONAL AMPLIFIERS:** Block diagram of a typical Opamp, Ideal Opamp, Open loop Opamp configurations, Opamp Characteristics, closed loop Opamp configurations, voltage series feedback or Non inverting amplifier, Voltage shunt feedback or inverting amplifier, Summing scaling and averaging amplifiers, Subtractor, voltage to current converter, current to voltage converter, Integrator, Differentiator, Comparator.	5
6	**MINIMIZATION TECHNIQUES** Sum of Products and Products of Sum forms, Minterms & Maxterms, Karnaugh Map for two, three, four five and six variables.	4
7	**COMBINATIONAL CIRCUIT DESIGN** Half adder, full adder, subtractor, BCD adder, comparator, code converter, encoder decoder, multiplexer, demultiplexer, parity detector and generator	4
8	**FLIP FLOPS** 1-bit memory cell, clocked and unclocked flip flops, S-R Flip flop, D flip flop, JK Flip flop, T flip flop, edge triggered flip flop, race around condition , Master slave flip flop.	4
9	**COUNTERS AND SHIFT REGISTERS** Ripple counter, design of Mod-N ripple counter, synchronous counter, decade counter, serial in serial out shift register, serial in parallel out shift register, parallel in serial out shift register and parallel in parallel out shift register, bidirectional shift register, universal shift register.	5
10	**DIGITAL MEMORIES & PROGRAMMABLE LOGIC** ROM, RAM (static and dynamic), PROMS, PLA and PAL	4

Course Outcomes: By the end of this course, the students will be able to	
1	Describe the behavior of electronic devices such as diodes, transistors and FETs.
2	Explain basic building blocks of operational amplifier, their functioning and demonstrate its various applications in analog systems.
3	Identify the components of combinational and sequential circuits and their operation.
4	Compare the different memories.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Integrated Electronics, Millman & Halkias, TMH.	2008

2	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky, PHI	2009
3	Circuits and Networks: Analysis and Synthesis, Sudhakar and Shyam Mohan, TMH	2009
4	Electronics Circuit Analysis and Design, Donald A. Neamen, Tata McGraw Hill	2008
5	Digital Design by Morris Mano, PHI, 4th edition	2008
6	Digital principles and Applications, by Malvino Leach, TMH	2011

Course Name	**:**	**SIGNALS AND SYSTEMS**
Course Code	**:**	**ECN 202**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:

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

1. Analyze continuous and discrete time signals & systems
2. Analyze communication systems in time and frequency domain.
3. Comprehend signals based on Fourier transform and study the impulse response of RC &RL networks, pulse response of RL, RC networks.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CONTINUOUS TIME SIGNALS:** Signals and their classification, size of the signal, continuous and discrete time signal properties-periodicity, absolute integral, convolution, Hilbert transform, signal operations on elementary CT/DT signals: Shifting, flipping, multiplication, addition, modulation.	10
2	**DISCRETE TIME SIGNALS :** Sampling, Aperiodic signal representation by Fourier integral, concept of continuous and discrete spectrum, essential and absolute bandwidth, correlation, auto-correlation and cross-correlation and their properties, energy spectral density, power spectral density, calculation of the energy and power signal respectively, properties of Fourier transform and applications. Discrete time Fourier transform(DTFT), Inverse DTFT.	10
3	**SYSTEMS** Systems and their classification, Linear Time invariant systems and its properties, stability and causality, linear constant coefficients, difference equation, Z-Transform and its properties, inverse z transform, Examples. Continuous and discrete time systems and their applications, band pass signals, band pass systems.	8
4	**TIME AND FREQUENCY DOMAIN ANALYSIS** Representation of basic circuits in terms of generalized frequency and their response, step response of RL, RC, RLC circuits, impulse response of RC & RL networks, pulse response of RL, RC networks.	6
5	**INFORMATION THEORY**: Concept of information, Entropy, Rate of Information Transmission, Redundancy, Efficiency and Channel capacity-Coding theory-Minimum Redundancy Coding-continuous channel, Transmission Rate and Capacity of Continuous Channels	8

Course Outcomes: By the end of this course student will be able to:	
1	Understand in detail continuous and discrete signals and systems and solve problems based on them
2	Solve different types of problems based on z transform and discrete time fourier transform
3	Solve problems relevant to communication channel, capacity and coding

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/**

		Reprint
1	Modern Digital & Analog Communication Systems by B.P. Lathi, pub. Oxford Univ. Press, 3rd Edition	2009
2	Signal And System by M.J. Robert, TMH, Third Edition.	2008
3	Signals and systems by A.V. Oppenheim & A.S. willisky, 2nd edition, Pearson education.	2006
4	Introduction to Communication Theory by P.D. Sharma	Latest Edition
5	Circuits and Networks (Analysis and synthesis):- Sudhakar, Shyammohan	2007

Course Name	**:**	**DIGITAL SIGNAL PROCESSING**
Course Code	**:**	**ECN 209**
Credits	**:**	**4**
L T P	**:**	**3 -1-0**

Course Objectives:

By the end of this course, students should be able to define concepts of DSP such as LTI Systems, stability, causality and differential equations, explain various transformation and design techniques and implementation of IIR and FIR filters.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**TRANSFORMATION OF DISCRETE SIGNALS** Typical applications of DSP, Discrete Fourier Transform(DFT) and its properties, IDFT, Fast Fourier Transform (FFT), Decimation in time and decimation in frequency algorithms, IFFT	8
2	**DIGITAL FILTERS** Recursive and non recursive systems, Frequency domain representation of discrete time systems, systems function, Ideal low pass filter	4
3	**DESIGN OF IIR FILTERS** Impulse invariance transformation technique, Bilinear transformation, Design of IIR Filters using Butterworth, chebyshev and elliptic filter , Digital frequency transformation	9
4	**DESIGN OF FIR FILTERS** Design of FIR filters using Window technique, frequency sampling technique, Equiripple Approx. technique, comparison of IIR and FIR filters	8
5	**REALIZATION OF DIGITAL SYSTEMS** Block diagrams and signal flow graphs for FIR and IIR systems, Direct form, cascade and parallel form realization of FIR and IIR systems.	4
6	**DSP PROCESSOR** Introduction to fixed point and floating point processors , architecture of a DSP processor	2
7	**MULTIRATE DSP & APPLICATIONS** Multirate DSP and its applications, Decimation, Interpolation, Sampling Rate Conversion	4
8	**ADAPTIVE WEINER FILTER** Adaptive Weiner filter & its application in echo cancellation and equalization	3

Course Outcomes: By the end of this course student will be able to:	
1	Define LTI systems, DTFT ,FFT
2	Explain various design techniques of IIR and FIR digital filters
3	Explain the realization of IIR and FIR filters
4	Outline the concept of DSP processor

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Digital Signal Processing by Proakis & Manolakis, Pearson Education	2006
2	Digital Signal Processing by A.V Oppenheim and R.W.Schafer, Pearson Education	2006
3	Digital Signal Processing by E C Ifeachor and B W Jervis .	2001
4	Digital Signal Processing by S Salivahanan, A Vallavraj, C Gyanapriya, TMH	2011
5	Digital Signal Processing By S. K. Mitra , TMH	2010

Course Name	**:**	**MICROPROCESSOR AND MICROCONTROLLER**
Course Code	**:**	**ECN 432**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

At the end of the course, the students should be able to explain the architecture and programming of 8085microprocessor and 8051 microcontroller. The student should be able to demonstrate various interfacing techniques.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**8085 MICROPROCESSOR:** Introduction to Microprocessors and Microcomputers, 8085 Microprocessor architecture, Pin configuration, GPRs, Flags, Data bus, Address bus, other signals, 8085-based microcomputer.	6
2	**PROGRAMMING AND INTERFACING FOR 8085:** Programming model, instruction classifications, Addressing Modes, opcode and operand, fetch and execution cycle, timing diagram, machine cycle, instruction cycle and T states. Data Transfer, Arithmetic, Logical Branch and Machine control group of instructions-programming examples. Memory interfacing concepts and examples, Basic interfacing concepts.	10
3	**STACKS AND SUBROUTINES:** Stack, subroutine, restart, and conditional call and return instructions.	3
4	**COUNTERS AND TIME DELAYS:** Counters and time delays, generating pulse waveforms	3
5	**INTERRUPTS OF 8085:** Vectored and non-vectored, maskable and non-maskable interrupts, Use of RIM and SIM instructions.	3
6	**8051 MICROCONTROLLERS:** Architecture, Pin configuration, SFR's, Memory, 8051 Addressing modes	4
7	**8051 INSTRUCTIONS:** Introduction to 8051 assembly language programming: JUMP, LOOP and CALL instructions, Arithmetic instructions: Unsigned addition and subtraction, unsigned multiplications and Division, signed number concepts and arithmetic operations, Logic and Compare instructions.	5
8	**I/O PORT PROGRAMMING:** Single bit instruction programming, Single bit operations with CY, Programming 8051 timers, counter programming, generating pulse waveforms.	5
9	**8051 INTERRUPTS:** Programming Timer Interrupts, Programming External Hardware Interrupts.	3

Course Outcomes: By the end of this course student will be able to:

1	Explain the functioning of microprocessor and microcontrollers.
2	Demonstrate microcontrollor based projects.
3	Enhance the programming skills.
4	Identify the importance of Assembler Directives and Operators.
5	

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Microprocessor, Architecture Programming and Application with 8085 by- R.S Gaonkar, Penram Publications.	2013
2	The 8051 Microcontroller and Embedded System by- Muhammad Ali Mazidi, Janice Gillespie Mazidi, Pearson Education Publications.	2013
3	Microprocessors and Peripherals by- B.Brey, CBS.	1989
4	The 8051 Microcontrollers by- Ayala, Penram Publications.	2010

Course Name	**:**	**COMMUNICATION SYSTEMS**
Course Code	**:**	**ECN 433**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
By the end of this course, the students should be able to describe the basics of analog communication systems, Various Modulation Techniques, the effects of noise, describe the basics of digital communication systems and Various Modulation Techniques. The student should also be able to explain the fundamentals of optical communication systems, satellite communication and mobile communication.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO COMMUNICATION SYSTEMS:** Principles of Communication (Analog and Digital), Block Diagram and subsystem description, Signal to Noise Ratio, Channel Bandwidth, Rate of Communication, Modulation.	2
2	**NOISE AND INTERFERENCE:** Classification of noise, sources of noise, atmospheric noise, shot noise, thermal and white noise, noise spectral density, noise calculations, Noise Figure of Devices, Circuits and Cascaded Networks, Experimental Determination of NF, Noise Calculations for different Communication Systems.	4
3	**ANALOG MODULATION TECHNIQUES:** Characteristics of AM and FM; Generation and detection techniques for Amplitude Modulation(AM)-Full Carrier, AM-Double sideband, Single Side Band, FM and PM.	8
4	**RADIO RECEIVER:** Super heterodyne receivers and their characteristics.	4
5	**PULSE MODULATION SYSTEMS:** Sampling theorem, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Pulse Code Modulation, Differential PCM, Delta Modulation, Adaptive Delta Modulation.	4
6	**DIGITAL MODULATION TECHNIQUES:** Generation, detection and probability of error analysis of OOK,BPSK, coherent and non-coherent FSK, QPSK and DPSK;QAM, MSK and multicarrier modulation; Comparison of bandwidth and bit rate of digital modulation schemes.	8

7	**ADVANCED COMMUNICATION SYSTEMS:** **Satellite Communication**: Types of satellite orbits, satellite transponder, multiple access techniques, basic link design. **Mobile Communication**: Cellular concepts, propagation characteristics, GSM and CDMA standards. **Optical Communication**: Optical fiber propagation, loss and dispersion, types of fibers, Optical sources and detectors, Optical link.	12

Course Outcomes: By the end of this course, the students will be able to	
1	Explain the block diagram of analog communication system, various modulation techniques, functional blocks of transmitter and receiver.
2	Explain the block diagram of digital communication system, various modulation techniques used and compare them.
3	To explain the fundamentals of optical communication systems, satellite communication and mobile communication.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Electronic Communication Systems by G. Kennedy And B. Davis, Mc Graw Hill, 4th Edition	2006
2	Modern Digital & Analog Communication Systems by B.P. Lathi, Oxford University Press,4th Edition	2009
3	Electronic Communications,4th Edition, Roddy & Coolen, Prentice Hall	1995
4	Principles Of Communication Systems by Taub and Schilling, Tata McGraw-Hill Education,	2008
5	Electronic Communications System: Fundamentals Through Advanced, 5/e, Pearson Education India	2003

Course Name	**:**	**VIRTUAL INSTRUMENTATION**
Course Code	**:**	**ECN 461**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to develop a fully virtual instrument (VI), capable of acquiring, processing, displaying and storing real time bio-signals, by the end of the semester. Students will be able to understand the basics of virtual instrumentation including use of IEEE GPIB, RS232 interfaces, and data acquisition boards and interfacing of a computer to various instruments for data acquisition and instrument control using a state of the art software platform such as National instrument's LABVIEW.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**GRAPHICAL SYSTEM DESIGN:** Graphical system design model (GSD),Design with GSD, Virtual instrument & Traditional Instrument, Virtual Instrumentation in engineering process, LabVIEW and VI, Comparison between conventional programming and graphical programming.	3
2	**INTRODUCTION TO LABVIEW:** Components of LabVIEW, front panel, Tools and other Palettes, controls and indicators, data types and conversions, operations on numbers, loops (FOR, WHILE), Feedback, Auto indexing, Local Variable, Global Variables, Shift Registers, sub-VI creation, sequence structure, case structure, Formula Node,Arrays and cluster, Inter-conversion of arrays and	8

	clusters, charts and graphs and property nodes, state machines, strings and string manipulation, output to files and input from files.	
3	**DATA ACQUISITION:** Basic of data acquisition (Classification of signals, Real World signals, Analog Interfacing, Connecting the signal to board, Practical Vs. Ideal interfacing), Signal conditioning, DAQ Hardware Configuration, Measurement and Automation Explorer, Interfacing with assistants (DAQ assistant, analysis assistants, Instrument assistants).	6
4	**INSTRUMENT CONTROL:** Introduction, GPIB communication, Hardware specifications, Software Architecture, Instrument I/O assistant, VISA, Instrument Drivers, Serial Port Communication.	5
5	**IMAQ VISION:** Vision Basics, Image processing and analysis, particle analysis, Machine Vision, Machine Vision Hardware and Software.	5
6	**MOTION CONTROL:** Components of motion control system. Software for configuration, prototyping and development, motion controller, move types, motion amplifier and drives, feedback devices and motion I/O.	7
7	**VIRTUAL INSTRUMENTATION APPLICATIONS (BASED ON LABVIEW):** Development of a complete application in any of these fields like communication system (analog and digital communication), control system (motion control, temperature, current control etc.), Digital Signal Processing (Fourier transforms, power spectrum, correlation methods, windowing & filtering), Image acquisition and processing etc.	8

Course Outcomes: By the end of this course, the students will be able to:	
1	Acquire knowledge on how Virtual Instrumentation can be applied for data acquisition and instrument control.
2	Identify salient traits of a virtual instrument and incorporate these traits in their projects.
3	Experiment, analyze and document in the laboratory prototype measurement systems using a computer, plug-in DAQ interfaces and bench level instruments.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Gary Johnson, "LabVIEW Graphical Programming", 2nd Edition, McGraw Hill, New York,	1997.
2	Lisa K. wells & Jeffrey Travis, "LabVIEW for everyone", Prentice Hall, New Jersey,	1997.
3	Sanjay Gupta & J.John, " Virtual Instrumentation Using LabVIEW", Electrical Engineering Series, The Tata McGraw-Hill, New Delhi, India.	2005
4	Robert H.Bishop, "Learning with LabVIEW™ 7 Express", Pearson Education, Delhi, India,	2005.
5	LabVIEW manual.	

Course Name	**:**	**NEURAL NETWORKS AND FUZZY SYSTEMS**
Course Code	**:**	**ECN 403**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

At the end of the course, the students should have knowledge of different Neural Networks and problems based on pattern classification and recognition. Students should also be able to design various real time applications using the concepts of Fuzzy Logic systems.

Total No. of Lectures – 42

Lecture wise breakup	**Number of**

		Lectures
1	**INTRODUCTION TO NEURAL NET:** Artificial Neural Networks, Biological Neural Networks, Applications of Neural Nets, Architecture of Neural Networks, History of Neural Networks, MC Culloch-Pitt Neuron.	4
2	**PATTERN CLASSIFICATION:** Biases and threshold, Linear separability, Hebbnet, Perceptron, Adaline, Madaline.	4
3	**PATTERN ASSOCIATION:** Training Algorithms for Pattern Association, Heteroassociative Memory Neural Network, Auto associative Net, Iterative Auto associative Net, Bidirectional Associative Memory (BAM).	6
4	**NEURAL NETWORKS BASED ON COMPETITION:** Maxnet, Mexican Hat, Hamming Net, Kohonen Self Organizing Maps, Learning Vector Quantization, Full and Forward Counterpropagation.	6
5	**ADAPTIVE RESONANCE THEORY:** Introduction, Architecture and algorithm of ARTI and ART2.	4
6	**BACKPROPAGATION NEURAL NET:** Standard Back propagation, Architecture, Algorithm, Variations, Derivation of learning rules.	4
7	**FUZZY LOGIC AND SETS:** Concepts of fuzzy logic, Crisp and fuzzy sets, properties of fuzzy sets, operations on fuzzy sets, fuzzy relations, operations on fuzzy relations.	6
8	**FUZZY LOGIC SYSTEM COMPONENTS:** Membership function, features of membership function, fuzzification, membership value assignment, fuzzy decision making, fuzzy system,	4
9	**FUZZY RULE BASED SYSTEM:** Formation of rules, decomposition of rules, aggregation and properties of fuzzy rules, fuzzy interference systems.	4

Course Outcomes: By the end of this course student will be able to:	
1	Describe the concepts of feed forward neural networks.
2	Explain Adaptive neural networks.
3	Design various networks for real time applications.
4	Summarize the concept of fuzziness involved in various systems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Fundamentals of Neural Networks, Laurence Dausett, Pearson Education	2006
2	Neural networks and Fuzzy Logic, K VinothKumar,R. Saravana Kumar, Katson Books	2012
3	Neural Netorks and machine learning, Haykin, Pearson Education	2008
4	Neural Networks, Satish Kumar, TMH	2012

Course Name	**:**	**MICROCONTROLLERS AND THEIR APPLICATIONS**
Course Code	**:**	**ECN 462**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, student should be able to understand the functioning of microcontroller, and its interfacing, importance and need of support chips and their functioning. The students should also develop programs for the various applications of microcontrollers.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**DIGITAL LOGIC:** Boolean algebra, Logic Families, TTL, Gates, Latches, Encoders & Decoders	2
2	**8051 MICRO CONTROLLERS:** Architecture, Pin configuration, SFR's, Memory, 8051 Addressing modes.	3
3	**8051 INSTRUCTIONS:** Introduction to 8051 assembly language programming: JUMP, LOOP and CALL instructions, Arithmetic instructions: Unsigned addition and subtraction, unsigned multiplications and Division, signed number concepts and arithmetic operations, Logic And Compare instructions, BCD and ASCII Application Programs. Role of Assembler.	5
4	**I/O PORT PROGRAMMING:** Single bit instruction programming, Single bit operations with CY, Reading Input Pins Vs Port latch, Programming 8051 timers, counter programming.	5
5	**INTERFACING WITH 8051:** LCD & Keyboard Interfacing, ADC,DAC and Sensor Interfacing	5
6	**SERIAL COMMUNICATION** 8051 connection to RS 232, 8051 serial communications Programming.	2
7	**INTERRUPTS:** Programming Timer Interrupts, Programming External Hardware Interrupts, Programming the Serial Communication Interrupts, Interrupt Priority in the 8051.	3
8	**PIC18F FAMILY:** Architecture of PIC 18F Microcontroller, PIC18F instructions and assembly language.	3
9	**PROGRAMMING MODEL:** PIC18F programming model, instruction set, instruction format. Data copy, arithmetic, branch, logical, bit manipulation and multiply-divide instructions. Stacks, subroutines and macros. Role of Assembler.	8
10	**INPUT/OUTPUT PORTS AND INTERFACING:** PIC18 I/O ports and interfacing with peripherals.	3
11	**INTERRUPTS AND TIMERS OF PIC:** Concepts of Interrupts and Timers. Interrupts and their implementation in PIC18.	2
12	**SERIAL I/O:** Concept of serial I/O. EIA-232 and PIC18 serial communication module. Serial Peripheral Interface, Inter-integrated Circuit Protocol.	3

Course Outcomes: By the end of this course student will be able to:	
1	Explain the architecture and functioning of various microcontrollers in detail.
2	Analyze interfacing, I/O communication and interrupts of these microcontrollers.
3	Develop programs for the various applications of microcontrollers

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	The 8051 Microcontroller and Embedded System by- Muhammad Ali Mazidi, Janice Gillespie Mazidi, Pearson Education Publications.	2007
2	Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family), Ramesh Gaonkar, Penram International Publishing, 2007 edition.	2007

Course Name	**:**	**DIGITAL IMAGE PROCESSING**

Course Code	**:**	**ECN 402**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to familiarize with the fundamentals of image processing, transformation techniques, and design & applications of image processing. The students should also be able to provide a useful skill base that would allow them to carry out further study should they be interested and to work in the field.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**FUNDAMENTALS OF IMAGE PROCESSING:** Introduction ,Steps in image processing systems, Image acquisition, Sampling and Quantization , Pixel relationships , Color fundamentals and models, File formats, Image operations, Arithmetic, Geometric and Morphological.	9
2	**IMAGE ENHANCEMENT:** Spatial Domain: Gray level Transformations, Histogram processing, Spatial filtering smoothing and sharpening. Frequency Domain: Filtering in frequency domain, DFT, FFT, DCT, Smoothing and sharpening filters – Homomorphic Filtering.	9
3	**IMAGE SEGMENTATION AND FEATURE ANALYSIS:** Detection of Discontinuities, Edge operators, Edge linking and Boundary Detection, Thresholding, Region based segmentation, Morphological Watersheds, Motion Segmentation, Feature Analysis and Extraction.	8
4	**MULTI RESOLUTION ANALYSIS AND COMPRESSIONS:** Multi Resolution Analysis: Image Pyramids, Multi resolution expansion, Wavelet Transforms, Image compression: Fundamentals, Models, Elements of Information Theory, Error free compression, Lossy Compression, Compression Standards.	8
5	**APPLICATION OF IMAGE PROCESSING:** Image classification, Image recognition, Image fusion, Stereography, Colour Image Processing. Pattern recognition.	8

Course Outcomes: By the end of this course, the students will be able to:	
1	Acquire the fundamental concepts of a digital image processing system.
2	Design and implement with Mat lab algorithms for digital image processing.
3	Utilize the skill base necessary to further explore advanced topics of Digital Image Processing.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Pearson Education	2001
2	Milan Sonka, ValclavHalavac and Roger Boyle, "Image Processing, Analysis and Machine Vision", 2nd Edition, Thomson Learning	1998
3	Anil K. Jain, "Fundamentals of Digital Image Processing". Pearson Education,	1989

Course Name	**:**	**NANO TECHNOLOGY**
Course Code	**:**	**ECN 413**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:

By the end of this course students should be able to describe the evolution and basics of nano technology, explain the various synthesis and nanofabrication process and their applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO NANOTECHNOLOGY AND NANO MATERIALS** History, ethical issues, applications in different fields, bottom up and top down approaches, Introduction to Zero, One and Two Dimensional Nanostructures, Quantum devices: Resonant tunneling diode, Coulomb Blockade, Single Electron Transistor.	**12**
2	**NANOMATERIAL SYNTHESIS TECHNIQUES** Physical methods: ball milling, Atomic Layer Deposition, Molecular beam epitaxy, spray pyrolysis, Chemical Methods: Sol gel, self-assembly, Chemical Vapor depositions, template manufacturing.	**10**
3	**NANO-FABRICATION** High resolution nano lithography, E-beam and nano imprint lithography, Dip-Pen lithography, AFM Lithography. Nano characterization: High Resolution TEM, Scanning Probe Microscopes: Atomic Force Microscope and Scanning Tunneling Microscope, Nano manipulator, Lab on a Chip concept.	**8**
4	**APPLICATIONS** Carbon nanotubes, structures and synthesis, growth mechanism and properties, devices applications, Nanowires: synthesis and characterization, Molecular Switches and logic gates.	**12**

Course Outcomes: By the end of this course the student will be able to	
1	Outline the importance of nano dimensional materials and their applications.
2	Realize and explain that the growth of nano-materials.
3	Characterize and study the properties of material
4	Demonstrate the applications of nano electronic devices and understand their basic principles.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Nanotechnology: Principles and Practices by Sulbha Kulkarni,Capital Publishing	2011
2	Hand book of Nanotechnology (3rd Edition) by Bhushan, Springer	2007
3	Nano: The Essentials: Understanding Nanoscience and Nanotechnology by T. Pradeep, McGraw Hill Professional	2008
4	Fundamentals of Microfabrication and Nanotechnology (3rdEdition) by Marc Madou, CRC Press	2011

GENERAL SCIENCE COURSES (GSC)

Course Name	**:**	**ENVIRONMENTAL SCIENCES**
Course Code	**:**	**GSC101**
Credits	**:**	**3**
L T P	**:**	**3 0 0**

Course Objectives:
This course aims to acquaint students with the basics of Environmental Sciences.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Multi-discipline nature of environmental studies as applied to different engineering streams - Definitions, scopes and explanations.	6
2	Types of Ecosystems – System dynamics – Understanding ecosystems, Ecosystem degradation, Resource utilization, Ecosystem diversity, Habitat classification.	6
3	Natural Resources; Renewable and non-renewable- Natural resources and associated problems, Non-renewable resources, Renewable resources	6
4	Energy and Environment- Fossil fuel, Geothermal, tidal, nuclear, solar, wind, hydropower & biomass.	6
5	Environment pollution- Air Pollution, Water Pollution, Soil Pollution, Marine Pollution, Noise Pollution, Thermal Pollution, Nuclear hazards	6
6	Cleaner Production and life cycle analysis: - LCA methodology, steps and tools, EIA and Environment audit	6
7	Environment Development and Society:- Emerging technology for sustainable development and environment management, public participation and provision in management and legislation.	6

Course Outcomes:	
1	Students will be able to relate the importance of Environmental Sciences for sustainable development of society.
2	Students will be able to understand the problems and remedies of Environmental Sciences.

Text Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Environmental Science Ceonage Learning Publication, Miller G.T. and Spool Mar
2	Environmental Studies, Tata McGraw Hill Pub., Banny Joseph

BASIC SCIENCE COURSES (BSC)

Course Name	**:**	**MATHEMATICS I**
Course Code	**:**	**MAN 101**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
To make the students understand the behavior of infinite series and their use. To make the students learn the concepts related to functions of several variables and their applications. To make the students learn the methods of evaluating multiple integrals and their applications to various problems. To make the students learn the methods to formulate and solve linear differential equations and apply them to solve engineering problems.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INFINITE SERIES** Infinite series and convergence, alternating series, power series and convergence. Taylor's and Maclaurin's Series. (Scope as in Chapter 8, Sections 8.1, 8.3 – 8.9 of Reference Book 1).	8
2	**MULTIVARIABLE FUNCTIONS** Limit, Continuity and Partial Derivatives; Euler's Theoem for Homogeneous functions; Differentiability, Linearization and Differentials; Chain rule; Extreme values and Saddle Points; Lagrange multipliers; Taylor's Formula**.** (Scope as in Chapter 12, Sections 12.1 – 12.6, 12.8 – 12.10 of Reference Book 1).	10
3	**SOLID GEOMETRY** Cylinders and Quadric surfaces, Cylindrical and Spherical Coordinates. (Scope as in Chapter10, Sections10.6 and 10.7 of Reference Book 1)	4
4	**INTEGRAL CALCULUS** Area between plane curves; Volumes of solids of revolution; Lengths of plane curves; Areas of surfaces of revolution. Double integrals in rectangular and Polar form, Triple integrals in Rectangular, Cylindrical and Spherical coordinates, Substitutions in Multiple Integrals. (Scope as in Chapter 5, Sections 5.1, 5.3, 5.5, 5.6 and Chapter 13 .Sections 13.1, 13.3, 13.4,13.6 and 13.7 of Reference Book 1).	8
5	**ORDINARY DIFFERENTIAL EQUATIONS** First order exact differential equations, Integrating factor, Orthogonal trajectories, Second and Higher order Linear Differential Equations with constant coefficients, Differential Operators, Methods of Variation of Parameters and Undetermined Coefficients, Euler Cauchy Equation, Wronskian. (Scope as in Chapter 1, Section 1.5, 1.8 Chapter 2, 2.1-2.4, 2.6, 2.9-2.10, 2.13- 2.15 of Reference Book 2).	12

Course Outcomes:	
1	The students are able to test the behavior of infinite series.
2	The students are able to analyze functions of several variables and their applications.
3	The students are able to evaluate multiple integrals and apply them to practical problems.
4	The students are able to solve linear differential equations.

Reference Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	G. B. Thomas, R. L. Finney. Calculus and Analytic Geometry, Ninth Edition, Pearson Education.
2	E. Kreyszig. Advanced Engineering Mathematics, Eighth Edition, John Wiley.
3	B. V. Ramana. Higher Engineering Mathematics, Tata McGraw Hill.

Course Name	**:**	**PROBABILITY AND STATISTICS**
Course Code	**:**	**MAN 103**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to use statistical methods to collect and analyze the data. The students should be able to estimate unknown parameters of populations and apply the tests of hypotheses.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**RANDOM VARIABLES AND PROBABILITY DISTRIBUTIONS** **Random variables, Discrete, Continuous and Joint Probability distributions, Marginal and Conditional distributions, Independent random variables, Expectation, Variance and Covariance, Means and variances of linear combinations of random variables, Chebyshev's inequality, Binomial, Poisson, Uniform and Normal distributions, Normal and Poisson approximations to Binomial, Moments, Moment generating function.**	20
2	**SAMPLING DISTRIBUTIONS & ESTIMATION** **Population, Sample, Sampling distributions, Law of large numbers, Central limit theorem, Distribution of sample mean, Difference of means, Proportions and difference of proportions, Chi-square distribution, Student's t-distribution, Estimation of parameters, Point estimate, Confidence interval for mean, difference of means and proportions.**	16
3	**TESTS OF HYPOTHESES** **Hypothesis, Test statistic, Critical region, Significance level, Single Sample and Two Samples tests for mean.**	6

Course Outcomes: By the end of this course, the student will be able to:	
1	Collect and analyze the data statistically.
2	Describe sampling distributions of sample means and sample proportions
3	Estimate unknown parameters of the population from a sample.
4	Construct confidence intervals for mean difference of means and proportions; and perform hypothesis tests for means.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Probability and statistics for Engineers and Scientists, Walpole, Myers, Myers and Ye, Pearson Education	2012
2	**Introduction to Mathematical Statistics, Hogg and Craig, Pearson Education**	2013
3	**Miller and Freund's: Probability and Statistics for Engineers, Richard A. Johnson, Prentice Hall**	2010
4	**John E. Freund's: Mathematical statistics with Application, Miller and Miller, Pearson Education**	2012

Course Name	**:**	**VECTOR CALCULUS, FOURIER SERIES AND LAPLACE TRANSFORM**
Course Code	**:**	**MAN105**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to use concepts of vector calculus to analyze scalar and vector fields and compute the gradient, divergence and curl. They should be able to evaluate line, surface and volume integrals. The students should be able to expand functions in a Fourier series and apply Harmonic analysis to numerical data. They should be able to evaluate Laplace transforms and inverse Laplace transform and apply Laplace transforms to solve ordinary differential equations.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**VECTOR CALCULUS** Gradient, Divergence and Curl – their physical interpretation and representation in cylindrical and spherical coordinates. Line, surface and volume integrals; Green's theorem in the plane, Stoke's theorem, Divergence theorem; Irrotational and Solenoidal Fields, Applications to Science and Engineering.	20
2	**FOURIER SERIES** **Periodic functions, Trigonometric series, Fourier Series, Euler's formulae, Conditions for existence of Fourier series, Even and odd functions, Half range expansions, Complex Fourier series, Applications of Fourier series, Parseval's identity, Harmonic analysis.**	12
3	**LAPLACE TRANSFORM** **Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, Unit step function, Dirac's delta function, Differentiation and integration of transforms, Applications to differential equations.**	10

Course Outcomes:	
1	Use vector calculus to analyze scalar and vector fields and compute the gradient, divergence and curl.
2	Evaluate line, surface and volume integrals.
3	Apply Green's Theorem, Divergence Theorem and Stoke's theorem to evaluate integrals..
4	Expand a function in terms of its Fourier series and to apply harmonic analysis to numerical data.
5	Evaluate Laplace transforms and inverse Laplace transforms of functions.
6	Apply Laplace transforms to solve ordinary differential equations arising in engineering problems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Calculus and Analytic Geometry, G. B. Thomas and R. L. Finney, Pearson Education	2014
2	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
3	Advanced Engineering Mathematics, M.D. Greenberg, Pearson Education Asia	2010
4	Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill	2003

Course Name	**:**	**PARTIAL DIFFERENTIAL EQUATIONS AND SPECIAL FUNCTIONS**
Course Code	**:**	**MAN 106**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to formulate and solve linear and nonlinear partial differential equations and apply partial differential equations to engineering problems. The students should be able to solve ordinary differential equations using series solutions, describe special functions as solutions to differential equations and expand functions in terms of eigenfunctions and to solve Sturm Liouville's problems.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**PARTIAL DIFFERENTIAL EQUATIONS** **Formation and solution of first order partial differential equations, Linear equations of higher order with constant coefficients, Applications to Engineering problems.**	17
2	**SPECIAL FUNCTIONS** Series solution of differential equations, Power series methods, Series solution of Legendre's differential equation Legendre's polynomial, generating functions, Recurrence relations, Frobenius method, Series solution of Bessel's differential equation, Bessel's functions, Modified Bessel's functions, generating functions, Recurrence relations, Equations reducible to Bessel's equation, Sturm Liouville's problem, Eigen function expansions.	25

Course Outcomes: By the end of the course, the students will be able to	
1	Formulate and solve linear and nonlinear partial differential equations
2	Apply partial differential equations to engineering problems.
3	Solve differential equations using series solutions.
4	Describe special functions as solutions to differential equations**.**
5	Expand functions in terms of eigenfunctions and to solve Sturm Liouville's problems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
2	Advanced Engineering Mathematics, Wylie and Barrett, McGraw Hill	**2003**
3	**Elements of Partial differential equations, Sneddon, McGraw Hill**	**2006**

Course Name	**:**	**NUMERICAL ANALYSIS**
Course Code	**:**	**MAN 109**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to describe errors involved in computations and to estimate these errors. The students should be able to solve equations, apply numerical methods to interpolate, extrapolate, differentiate and integrate functions. They should be able to solve differential equation using numerical methods and solve systems of equations.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**ERRORS** **Errors in numerical calculations, Absolute, relative and percentage errors, Round off and truncation errors, Error propagation, Loss of significant digits, Errors in series approximation, Speed of convergence.**	5
2	**SOLUTION OF EQUATIONS** **Bisection method, Fixed point iteration and its convergence, Acceleration of convergence using Aitken's method; Regula-Falsi, Newton-Raphson, Generalized**	7

	Newton's, Chebyshev's and Halley's methods.	
3	**INTERPOLATION** **Lagrange Interpolation, Newton's divided difference interpolation, Finite differences, Newton's, Bessel's, Stirling's and Guass' difference formulae.**	10
4	**NUMERICAL DIFFERENTIATION & INTEGRATION** **Differentiation using differences, Integration using Newton-cote's formulas with errors, Gaussian Quadrature.**	8
5	**SOLUTION OF LINEAR SYSTEM OF EQUATIONS** Direct methods - Gauss elimination, Partial pivoting, Complete pivoting, Gauss-Jordan and factorization methods, Iterative methods-Gauss Siedal and Jacobi's methods.	6
6	**NUMERICAL METHODS FOR DIFFERENTIAL EQUATIONS** **Solution of first order differential equations using Taylor's series, Euler's, Picard's and Runge-Kutta method upto 4^{th} order, Predictor-Corrector methods (Adam's and Milne's method),**	6

Course Outcomes:	
1	Describe errors involved in computations and to estimate the errors.
2	Solve algebraic and transcendental equations using Bisection method Regula-Falsi, Newton-Raphson,
3	Generalized Newton's, Chebyshev's and Halley's methods.
4	Apply numerical methods to interpolate, extrapolate differentiate and integrate functions.
5	Solve systems of equations.
6	Solve differential equation using numerical methods.(Taylor's series, Euler's, Picard's and Runge-Kutta method upto 4^{th} order, Predictor-Corrector methods)

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Advanced Engineering Mathematics, E. Kreyszig, John Wiley	2006
2	Numerical Methods for Mathematics, Science and Engineering, Mathews, Prentice Hall	1992
3	An Introduction to Numerical Analysis, Atkinson, John Wiley	2012

Course Name	**:**	**OSCILLATIONS AND OPTICS**
Course Code	**:**	**PYN101**
Credits	**:**	**4**
L T P	**:**	**3 1/2 2/2**

Course Objectives:
To familiarize the students with Ultrasonics and their applications To acquaint the students with simple harmonic motion along with damping and driving forces To refresh the basics of interference, diffraction and polarization and familiarize the students with their applications through lectures and experiments To teach the students the basic concepts of LASER and to familiarize them various kinds of lasers To acquaint the students with fundamentals of holography

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**ULTRASONICS:** Production, detection and uses of ultrasonics, reverberation, sabine's formula (no derivation)	3
2	**SHM:** Review of basic kinematics (displacement, velocity, acceleration, time period and phase of vibration) and dynamics (restoring force and energetics) of simple harmonic	4

	motion, differential equation of SHM, superposition of two SHM in one dimension, charge oscillations in LC circuits	
3	**DAMPED OSCILLATIONS:** Concept and cause of damping, differential equation of a damped oscillator and different kinds of damping, Methods of describing damping of an oscillator - logarithmic decrement, relaxation time, quality factor, band width. Series LCR circuit as a damped oscillator.	4
4	**FORCED OSCILLATIONS:** States of forced oscillations, differential equation of forced oscillator – its displacement, velocity and impedance, behaviour of displacement and velocity with driver's frequency, Power, bandwidth, Quality factor and amplification of forced oscillator, resonance in forced oscillators, forced oscillations in series LCR circuit	5
5	**WAVE MOTION:** Wave equation and its solution, characteristic impedance of a string, reflection and transmission of waves on a string at a boundary, reflection and transmission of energy, the matching of impedances	3
6	**INTERFERENCE:** Division of wave front and amplitude; Fresnel's biprism, Newton's rings, Michelson interferometer and its applications for determination of λ and $d\lambda$.	4
7	**DIFFRACTION:** Fresnel and Fraunhofer diffraction, qualitative changes in diffraction pattern on moving from single slit to double slit, plane transmission grating, dispersive power & resolving power of a grating.	5
8	**POLARIZATION:** Methods of polarization, analysis of polarized light, quarter and half wave plates, double refraction.	4
9	**LASERS:** Elementary idea of LASER production, spontaneous emission, stimulated emission, Einstein's coefficients, Helium-Neon, Ruby and semiconductor lasers, applications of lasers.	4
10	**FIBRE OPTICS:** Basics of optical fibre - its numerical aperture, coherent bundle, step index and graded index fibre, material dispersion, fibre Optics sensors, applications of optical fibre in communication systems.	4
11	**HOLOGRAPHY:** Basic principle, theory and requirements.	2

List of Experiments:	
1	To find the wavelength of sodium light using Fresnel's biprism.
2	(i) To determine the wavelength of He-Ne laser using transmission grating. (ii) To determine the slit width using the diffraction pattern.
3	To determine the wave length of sodium light by Newton's rings method.
4	To determine the wave length of sodium light using a diffraction grating.
5	To find the specific rotation of sugar solution using a Bi-quartz Polarimeter.
6	To design a hollow prism and used it find the refractive index of a given liquid

Course Outcomes:	
1	Students are aware of latest developments in certain areas of Physics which have important applications for societal needs.
2	Students learn about lasers and fibre optics which have important applications for societal needs.
3	Students are expected to develop capability to tackle problems in general and in the various areas covered in the course.

Reference Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Physics for Engineers (Prentice Hall India) - N.K. Verma
2	Physics of Vibrations and Waves (5th Edition, John Wiley & Sons) – H.J.Pain
3	Optics – Ajoy Ghatak

Course Name	**:**	**CONDENSED MATTER PHYSICS**

Course Code	**:**	**PYN102**
Credits	**:**	**4**
L T P	**:**	**3 1/2 2/2**

Course Objectives:
To teach the students the basic concepts of crystal structure and defects To familiarize the students with the concepts of Free electron theory of metals and its applicability To acquaint the students with the concepts of Dielectric and Magnetics materials with their applications through lectures and experiments To impart to the students the concepts of superconductivity and nanotechnology To teach the students the basic concepts of crystal structure and defects

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CRYSTAL STRUCTURE:** Space lattices and their symmetries, crystal structures (cubic and hexagonal cells), assignment of coordinates, directions and planes in crystals, linear, planer and space densities in crystals, close packed morphology (Hexagonal and cubic close packing), single and polycrystalline structures, interstitial spaces (trigonal, tetrahedral and octahedral voids, crystal Structure analysis, X-ray diffraction and Bragg's law, crystal defects, Point, line, surface and volume imperfections	(11)
2	**THEORY OF METALS:** Free electron theory, electrical properties, thermal properties, motion in magnetic field (cyclotron resonance), Zone theory. Band theory of solids, Kronig-Penney Model (qualitative), conductors, insulators and semiconductors	(6)
3	**DIELECTRIC MATERIALS:** Review of basic formulas, dielectric constant and polarizability, sources of polarizability, classical treatment of dipolar, ionic and electronic polarizability, piezoelectricity, ferroelectrcity.	(5)
4	**MAGNETIC MATERIALS:** Review of basic formulas, magnetic susceptibility, classification of materials, Langevin diamagnetism, paramagnetism (only classical treatment), magnetism in metals, ferromagnetism in insulators, anti-ferromagnetism and ferrimagnetism, ferromagnetism in metals, ferromagnetic domains, hysteresis	(8)
5	**SUPERCONDUCTIVITY:** Zero resistance, occurrence of superconductivity, Meissner effect, critical field, thermodynamics of superconducting transitions, electrodynamics of superconductors, qualitative idea of BCS theory.	(4)
6	**SEMICONDUCTORS**: p-type and n-type semiconductors, statistics of electrons and holes, Hall effect (for single as well as both type of charge carriers)	(4)
7	**NANOTECHNOLOGY:** Introduction, Synthesis of Nanoparticles: Mechanical Method, Sputtering, Chemical Vapour Deposition, Sol-gel Technique, Applications of Nanotechnology	(4)

List of Experiments:	
1	To find the energy band gap of the given semiconductor by four probe method.
2	To study the Hall Effect of a given semiconductor.
3	To determine the dielectric constant of the given materials.
4	To study the B-H curve of the ferromagnetic materials.
5	To determine the value of e/m for electron by long solenoid (helical) method.
6	To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph.

Course Outcomes:	
1	Students learn about dielectric and magnetic materials which have important applications for societal needs.
2	Students learn about superconductivity and nanotechnology which have important applications.
3	Students are expected to develop capability to tackle problems in general and in the various areas covered in the course.

Suggested Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Material science and Engineering – An Introduction by William D Callister, Jr, Sixth Edition, John Wiley and Sons.
2	Material science and Engineering – A First Course by V.Raghvan Fourth Edition, Eastern Economy Edition
3	Solid State Physics (New Age Publishers) – S.O. Pillai
4	Introduction to Solids (Tata McGraw Hill, Third Edition) - Leonid V Azaroff

Course Name	**:**	**MECHANICS**
Course Code	**:**	**PYN - 105**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
To acquaint about the engineering aspects of Mechanics
To familiarize Kinematics and Kinetics of rigid body
To inculcate the application of Mechanic concepts in engineering
To familiarize the application of relative motion analysis in the design of energy system

Total No. of Lectures – 36

Lecture wise breakup		**Number of Lectures**
1	**KINEMATICS OF A PARTICLE**: Introduction. Rectilinear Kinematics: General Curvilinear Motion. Curvilinear Motion: Rectangular Components, Normal and Tangential Components, Cylindrical Components. Absolute Dependent Motion Analysis of Two Particles. Relative-Motion Analysis of Two Particles Using Translating Axes. Motion of a Projectile.	5
2	**KINETICS OF A PARTICLE: FORCE AND ACCELERATION**: Newton's Laws of Motion. The Equation of Motion. Equation of Motion for a System of Particles. Equations of Motion: Rectangular Coordinates, Normal and Tangential Coordinates, Cylindrical Coordinates. Central-Force Motion and Space Mechanics.	4
3	**KINETICS OF A PARTICLE: WORK AND ENERGY**: The Work of a Force. Principle of Work and Energy. Principle of Work and Energy for a System of Particles. Power and Efficiency. Conservative Forces and Potential Energy. Conservation of Energy.	3
4	**KINETICS OF A PARTICLE: IMPULSE AND MOMENTUM**: Principle of Linear Impulse and Momentum. Principle of Linear Impulse and Momentum for a System of Particles. Conservation of Linear Momentum for a System of Particles. Impact. Angular Momentum. Relation Between Moment of a Force and Angular Momentum. Angular Impulse and Momentum Principles.	4
5	**PLANAR KINEMATICS OF A RIGID BODY:** Rigid-Body Motion. Translation. Rotation About a Fixed Axis. Absolute General Plane Motion Analysis. Relative-Motion Analysis: Velocity, Instantaneous Center of Zero Velocity, Acceleration. Relative-Motion Analysis using Rotating Axes.	4
6	**PLANAR KINETICS OF A RIGID BODY: FORCE AND ACCELERATION:** Moment of Inertia. Planar Kinetic Equations of Motion. Equations of Motion: Translation, Rotation About a Fixed Axis, and General Plane Motion.	4
7	**PLANAR KINETICS OF A RIGID BODY: WORK AND ENERGY:** Kinetic Energy. The Work of a Force. The Work of a Couple. Principle of Work and Energy. Conservation of Energy.	3
8	**PLANAR KINETICS OF A RIGID BODY: IMPULSE AND MOMENTUM:** Linear and Angular Momentum. Principle of Impulse and Momentum. Conservation of Momentum. Eccentric Impact.	3

9	**THREE-DIMENSIONAL KINEMATICS OF A RIGID BODY**: Rotation About a Fixed Point. The Time Derivative of a Vector Measured from a Fixed and Translating-Rotating System. General Motion. Relative-Motion Analysis using Translating and Rotating Axes.	3
10	**THREE-DIMENSIONAL KINETICS OF A RIGID BODY**: Moments and Products of Inertia. Angular Momentum. Kinetic Energy. Equations of Motion. Gyroscopic Motion. Torque-Free Motion.	3

Course Outcomes:	
1	The student will be able to understand the concepts of Mechanics.
2	The students will be able to apply the concepts of Mechanics in fluid of energy.
3	The students will be able to understand various types of motion characteristic and found characteristic of rigid body.

Suggested Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	R.C. Hibbeler, Dynamics (11th Ed) Pearson Publishers.
2	F.P. Beer et al. Dynamics (8th Ed) Mc GrawHill Publishers.
3	Merriam and Kraige; Dynamics (5th Ed) Wiley and Sons Publications Merriam and Kraige.
4	R.C. Hibbeler, Statics (11th Ed) Pearson Publishers.

Course Name	**:**	**ELECTROMAGNETIC THEORY**
Course Code	**:**	**PYN-106**
Credits	**:**	**4**
L T P	**:**	**3 1/2 2/2**

Course Objectives:
At the end of the course, the student should be able to understand the classification of the vector fields. The student should be able to apply the concepts of electrostatics and boundary value problems. The student should be able to understand concepts of electromagnetic wave propagation.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**VECTORS AND FIELDS:** Cartesian coordinate System, Cylindrical and Spherical coordinate Systems, Constant coordinate surfaces, Del operator, Gradient, Divergence of a Vector and Divergence Theorem, Curl of a vector and Stoke's theorem, Gradient, Divergence, Curl and Laplacian in the three coordinate Systems, Laplacian of a scalar, Scalar & Vector Fields, Classification of Vector field. Sinusoidally time-varying fields, Complex Numbers and Phasor technique.	10
2	**ELECTROSTATICS:** Field intensity, Gauss's law & its applications, Maxwell's 1st eqn. (Electrostatics), Electric Energy and potential, the line integral, Potential gradient, the dipole fields, Energy density in an electrostatic field. Current and current density, Continuity of current, Metallic conductors, Conductor properties and boundary conditions, the nature of Dielectric materials and related Boundary conditions, Capacitance, Capacitance of a two-wire line, Current analogies. Electrostatic boundary-value problems, Laplace's and Poisson's equations, Uniqueness theorem, General procedure for solving Laplace's and Poisson's equation , Resistance and capacitance, Method of images.	10
3	**MAGNETOSTATICS:** Biot-Savart's law, Ampere's circuital law, Applications of Ampere's law, Magnetic flux and	11

	magnetic flux density-Maxwell's eqn., Maxwell's eqn. for static electromagnetic fields, Scalar and vector magnetic potentials. Magnetic dipole, Force due to Magnetic field on a differential current element, force between two differential current elements, Force and torque on a closed circuit, The nature of magnetic materials, Magnetization and permeability, Magnetic boundary conditions, Inductors and inductances, Magnetic energy, Magnetic circuits, Potential energy and force on magnetic materials.	
4	**MAXWELL'S EQUATIONS AND ELECTROMAGNETIC WAVE PROPAGATION:** Faraday's law, Displacement current, Maxwell's equations in point form, Maxwell's equations in integral form, Kirchoff's Voltage law and Kirchoff's Current law from Maxwell's equations, EM waves in general, EM wave propagation in Lossy Dielectrics, Wave propagation in lossless dielectrics, Plane waves in free space, Plane waves in Good conductors, Power & Poynting Vector, Reflection of a plane wave at normal incidence, Reflection of a plane wave at oblique incidence.	11

List of Experiments:		**Number of Turns**
1	To design a method to draw equipotential lines with various geometries of electrodes kept at different potentials	1
2	To study the variation of magnetic field with distance along the axis of a circular coil carrying current by plotting a graph	1
3	To find the energy band gap of the given semiconductor by four probe method	1
4	To study the Hall effect of a given semiconductor	1
5	To determine the dielectric constant of the given materials	1
6	To study the B-H curve of the ferromagnetic materials	1

Course Outcomes:	
1	By the end of the course, the student will be equipped with the tools of electromagnetic theory.
2	The student will be able to solve numerical problems based on vector fields, electrostatics, magnetostatics and electromagnetic wave propagation.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Engineering Electromagnetics, William H Hyat, Jr., and John A. Buck, Tata McGraw Hill	2013 / 5th edition
2	Elements of Engineering Electromagnetics, Matthew N.O. Sadiku, Oxford University Press	2012 / 4th edition
3	Introduction to Electrodynamics, D.J. Griffiths, Prentice Hall	2012 / 4th edition

Course Name	**:**	**APPLIED CHEMISTRY**
Course Code	**:**	**CHN101**
Credits	**:**	**4**
L T P	**:**	**3 0 3**

Course Objectives: Upon completion of this course, students will have fundamental knowledge of the following:
Concepts of water and its analysis, polymer chemistry, solid state chemistry, lubricants, coordination chemistry and substitution reactions as applied to various industries. Spectroscopic methods required for the characterization of engineering materials. Design and development of novel future engineering materials and processes.

Experiments related to applications of analysis and chemical processes relevant to various Industries.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**WATER TREATMENT AND ITS ANALYSIS:** Boiler feed water and its problems, Water Softening techniques, Domestic Water treatment, Chemical Analysis and related numerical problems	7
2	**POLYMER CHEMISTRY:** Classification, Mechanism and methods of polymerization, preparation, properties and uses of few engineering.	5
3	**SOLID STATE CHEMISTRY**: Introduction to structure and bonding-ionic solids, crystal defects and applications of defect structure (transistors, rectifiers, photovoltaic cells and computer chips).Introduction to ceramics.	6
4	**LUBRICANTS/ FUEL CELL TECHNOLOGY/CORROSION:** Functions mechanism, classification, properties and analysis of Lubricants and related numerical problems. Introduction to electrochemistry, types of electrodes, Reference electrodes, Ion-selective electrodes, Concentration cells, Batteries, Fuel cells/ Types of corrosion, dry and wet corrosion and their mechanisms, types of electrochemical corrosion, factors influencing corrosion, Prevention of corrosion.	6
5	**ATOMIC AND MOLECULAR SPECTROSCOPY: AAS**- Principle, instrumentation and applications of UV,IR and NMR spectroscopy and related problems.	10
6	**COORDINATION CHEMISTRY:** Crystal Field Theory, Splitting of octahedral, tetrahedral and square planner complexes, Applications of crystal field theory.	4
7	**AROMATIC ELECTROPHILIC AND NUCLEOPHILIC SUBSTITUTION:** Reaction mechanisms and applications.	4

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:	
1	Apply the knowledge for water treatment and its analysis for processing and its disposal which is relevant to all Industries for efficient utilization of water as an essential industrial resource.
2	Develop and design new materials based on knowledge of polymers, solid chemistry and substitution reactions
3	Hands on experience for carrying out experiments with precision for characterization and estimation of materials by wet analysis.
4	Will be able to carry out Instrument based spectroscopic analysis of new materials and interpretation of relevant data.

Reference Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Atkin's Physical Chemistry by Peter Atkins, Julio de Paula, 7th Edition, Oxford University Press.
2	Concise Inorganic Chemistry Vth Edition J D Lee 2003 (Chapman & Hall)
3	A Textbook of Engineering Chemistry by Shashi Chawla, Dhanpat Rai& Co. Pvt. Ltd.
4	Introductory Polymer Chemistry by G.S.Mishra, John Wiley & Sons, New York, 1993.
5	Basic Inorganic Chemistry by F.A. Cotton, G. Wilkinson and P.L. Gaus, 3rd Ed., John Wiley & Sons.
6	Puri, Sharma and Pathania : Principles of Physical Chemistry, W.H. Freeman & Co, 2008.
7	Organic Chemistry by Joseph M.Hornback Brooke/Cole Publishing Company U.S.A.
8	D. S. Pavia, G.M. Lasmpman and G.S. Kriz : Introduction to Spectroscopy, 4th Edition, Thomson learning, Indian Edition 208.
9	Chemistry for environmental engineering by C. N. Sawyer, P. McCarty, G. F. Parkin, Mc Graw Hill Inc, New York.

Course Name	**:**	**PHYSICAL CHEMISTRY**
Course Code	**:**	**CHN-102**
Credits	**:**	**4**
L T P	**:**	**3 0 3**

Course Objectives:
At the end of this course the students should be able to describe and implement concepts and principles of Physical Chemistry required for indepth understanding of Physical phenomena of materials in relation to applications in Engineering .

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CHEMICAL EQUILIBRIUM :** General characteristics of chemical equilibrium, thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant-Van't Hoff equation, Le Chatelier's principle.)	4
2	**SOLUTIONS**: Ideal and non-ideal solutions, Raoults's law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids such as Phenol- water, triethylamine- water, and Nicotine- water systems. Henry's law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.	8
3	**CHEMICAL KINETICS:** Rate equation of reactions of various orders, rate mechanism, kinetics of complex reactions. Concept of energy barrier and energy of activation. Theories of reaction rates, measurement of extent of reaction, zero order reactions. Rates of flow systems. Lindemann theory of unimolecular reactions.	8
4	**SURFACE PHENOMENA:** Adsorption of gases by solids. Types of adsorption, adsorption isotherms, Langmuir's adsorption equation, B.E.T. equation for determination of surface area of adsorbents, applications of adsorption, catalysis, kinetics of surface reactions. Introduction to micelles, emulsions and gels.	6
5	**PHASE EQUILIBRIA** : Phase rule and its thermodynamic derivation. One component systems-water, sulphur, Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems. Eutectics, freezing mixtures, ultra purity, zone refining.	6
6.	**ELECTROCHEMISTRY:** Conductance of electrolytic solutions, transference number and its determination, Kohlrausch's law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes, ionic equilibria. Ionizaton of water, ionization constants of weak acids and weak bases, hydrolysis, pH, common ion effect, solubility product and salt effect.	5
7.	**ELECTROCHEMICAL CELLS:** Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half- cell potential and its determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.	4

List of Experiments:		**Number of Turns**
1	Determination of Surface tension of liquids using Stalagmometer.	2
2	Distribution of Iodine between water and carbon tetrachloride.	2
3	Kinetics of the hydrolysis of methyl acetate in the presence of hydrochloric acid.	3
4	Adsorption of acetic acid on activated charcoal.	2
5	Conductometric and Potentiometric titrations and Colorimetry.	4

Course Outcomes: By the end of this course, the student will be able to-

1	Understand the phenomenon of chemical equilibrium, phase equilibria and effect of change of process parameters such as T, P, C etc both quantitatively and qualitatively.
2	Understand physical properties of solutions like change of free energy, entropy of mixing as applies to heat and mass transfer in chemical processes.
3	Analyse the kinetics of chemical processes that are useful in the design of reactors and optimisation of material processing and its implementation.
4	Apply concepts of various surface phenomenons for material coatings, separate technology and in catalytic processes.
5	Design the sensors based on the concepts of electrochemistry.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Principles of Physical Chemistry by Maron, Samuel H. Prutton, ; Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.	2002
2	Textbook of Physical Chemistry by Carl F. Glasstone, Samuel ; MacMillan and Co. Ltd. London	2010
3	Principles of Physical Chemistry by B.R Puri., L.R Sharma, and Pathania, S Madan,; S. Nagin &Co Jalandhar.	2013
4	Chemical Kinetics by Laidler , J Keith ;Tata McGraw-Hill Co. Ltd., New Delhi.	2002
5	A Text Book of Physical Chemistry by P.W Atkins; Oxford University Press.	2009
6	Findlay's Practical Physical Chemistry by B.P Lavitt. ; Longman Group Ltd.	1973

Course Name	**:**	**INORGANIC CHEMISTRY**
Course Code	**:**	**CHN-103**
Credits	**:**	**4**
L T P	**:**	**3 0 3**

Course Objectives: Upon completion of this course, students will have fundamental knowledge of the following:
Concepts of structure and chemical bonding essential for understanding of molecular structure. Solid state chemistry for application in electronics, ceramics and other advanced materials. Magnetic behaviour and catalytic properties of co-ordination and organometallic compounds used in various industries. Interaction and role of metals in biological systems essential for bio-engineering applications.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**QUANTUM THEORY AND ATOMIC STRUCTURE:** Introduction to wave mechanics, the Schrodinger equation, the Schrodinger equation as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals.	4
2	**CHEMICAL BONDING:** Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.	7
3	**THE SOLID STATE:** A recapitulation of close packing of spheres, structures of NaCl, CsCl, ZnS, CaF2, crystal defects and applications of defect structures (transistors, rectifiers, photovoltaic cells and computer chips).	4
4	**COORDINATION COMPOUNDS:** Part 1:Werner's theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination compounds (crystal field stabilization energies of	6

	octahedral and tetrahedral complexes, spectrochemical series).	
5	**COORDINATION COMPOUNDS:** Part2: Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - **SN^1**, SN^2). Magnetic behaviour of complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism and measurement ofmagnetic susceptibility of complexes by Guoy's method.	6
6	**ORGANOMETALLIC COMPOUNDS:** Nomenclature, types of ligands and bonding in organometallic compounds, use of organometallics in industry.	5
7	**INORGANIC POLYMERS: TYPES** of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties.	5
8	**ROLE OF METALS IN BIOLOGICAL SYSTEMS:** Bio-inorganic Chemistry of Iron – Heme proteins & Non-Heme iron proteins; bioinorganic chemistry of cobalt-vitamin B12 and metalloenzymes.	5

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:	
1	Apply the knowledge of quantum theory, chemical bonding and solid state, to know the structure and bonding required for the development of new materials.
2	Design new inorganic materials with desired physical and chemical properties.
3	Carry out experiments with precision related to synthesis and characterization of new industrially important inorganic materials.

Reference Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Sharpe, A. G. : Inorganic Chemistry, 3rd Edition, Longman Publishers ELBS, 1992.
2	Lee, J. D. : Concise: Inorganic Chemistry, 5th Edition, Chapman and Hall Publishers, 1996.
3	Cotton, F. A. & Wilkinson, G. : Advanced Inorganic Chemistry, 3rd Edition,Wiley Eastern Ltd., 1982.
4	Cotton, F. A. & Wilkinson, G. : Basic Inorganic Chemistry, Wiley EasternLtd., 1987. 12
5	Mark, J., West, R. & Allcock,H. : Inorganic Polymer, Prentice Hall, New Jersey Publishers, 1982.

Course Name	**:**	**PHYSICAL CHEMISTRY**
Course Code	**:**	**CHN-104**
Credits	**:**	**4**
L T P	**:**	**3 0 3**

Course Objectives:
Concepts of chemical equilibria, solutions, chemical kinetics and electrochemistry to the physical phenomena occurring in various chemical processes. Surfaces modification of important industrial materials used in adsorption and separating technology. Phase equilibria for understanding the physical behaviour of various materials such as alloys and other biphasic and triphasic systems. Experiments related to the theoretical studies of different physical phenomena relevant to various industries.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CHEMICAL EQUILIBRIUM:** thermodynamic derivation of the law of chemical equilibrium, Van't Hoff reaction isotherm. Relation between Kp, Kc and Kx. Temperature dependence of equilibrium constant- Le Chatelier's principle.	5
2	**SOLUTIONS:** Raoults's law, change of free energy, enthalpy, and entropy on mixing of liquids, distillation of binary solutions. Partially miscible liquids Henry's law, Nernst distribution law, Colligative properties of dilute solutions. Abnormal molar mass, degree of dissociation and association of solutes.	8
3	**CHEMICAL KINETICS**: Rate equation of various orders, rate mechanism, kinetics of	8

	complex reactions. Theories of reaction rates, measurement of extent of reaction, Rates of flow systems. Lindemann theory of unimolecular reactions.	
4	**SURFACE PHENOMENA**: Adsorption of gases by solids., adsorption isotherms., Langmuir's adsorption equation, B.E.T. equation for determination of surface area of adsorbents, applications of adsorption, catalysis, kinetics of surface reactions. Introduction to micelles, emulsions and gels.	6
5	**PHASE EQUILIBRIA** : Phase rule and its thermodynamic derivation. One component systems-water, sulphur, Two component systems, construction and interpretation of general phase diagrams for liquid-vapour, liquid-liquid and liquid-solid systems. Eutectics, freezing mixtures, ultra purity, zone refining.	6
6	**ELECTROCHEMISTRY:** transference number and its determination, Kohlrausch's law of independent migration of ions, Interionic attraction theory, activity and activity coefficients of strong electrolytes, ionic equilibria. Ionizaton of water, ionization constants of weak acids and weak bases, common ion effect, solubility product and salt effect.	5
7	**ELECTROCHEMICAL CELLS**: Reversible and irreversible cells, e.m.f. and its measurement, cell reactions and e.m.f., thermodynamics of electrode potentials, half- cell potential and its determination, Nernst equation, concentration cells, liquid junction potential, determination of activity co-efficient from cell potential data, potentiometric titrations.	4

Course Outcomes: Students who complete the course will have demonstrated the ability to do the following:	
1	Understand the relevance of the physical phenomena occurring in various materials and processes.
2	Modify the composition of various materials required for new technological applications.
3	Hands on experience for carry out experiments with precision related to chemical equilibria, surface phenomena and reaction kinetics required for designing various processes in Industry.

Suggested Books:	
Sr. No.	**Name of Book/ Authors/ Publisher**
1	Maron, Samuel H. Prutton, Principles of Physical Chemistry, Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
2	Carl F. Glasstone, Samuel Textbook of Physical Chemistry, MacMillan and Co. Ltd. London.
3	Puri,B.R.,Sharma,L.R.and Pathania,Madan,S. Principles of physical chemistry, S.Nagin & co Jalandhar.
4	Laidler, Keith J. Chemical Kinetics, Tata McGraw-Hill Co. Ltd., New Delhi.
5	Atkins, P.W. A Text Book of Physical Chemistry,Oxford University Press.

HUMANITIES, SOCIAL SCIENCES AND MANAGEMENT COURSES (HSSMEC)

Course Name	**:**	**ETHICS AND SELF AWARENESS**
Course Code	**:**	**HSS 101**
Credits	**:**	**2**
L T P	**:**	**2-0-0**

Course Objectives:
To provide basic knowledge about ethics, values, norms and standards and their importance in real life. To improve the personality of students by their self-assessment

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ETHICS** Concept of Ethics – Nature, Scope, Sources, Types, Functions and Factors influencing Ethics, Approaches to Ethics – Psychological, Philosophical and Social, Broader Ethical Issues in Society	**6**
2	**VALUES, NORMS, STANDARDS AND MORALITY** Concept and Role, Relation with Ethics, Psycho-Social Theories of Moral Development – Kohlberg and Carol Gilligan	**4**
3	**ETHICS AND BUSINESS** Concept of Business Ethics – Nature, Objectives and Factors influencing Business Ethics, 3 C's of Business Ethics, Ethics in Business Activities, Ethical Dilemmas in Business, Managing Ethics	**5**
4	**SELF-AWARENESS** Concept of Self Awareness – Need, Elements, Self Assessment – SWOT Analysis, Self Concepts – Self-Knowledge, Assertiveness and Self-Confidence, Self-Esteem	**4**
5	**SELF-DEVELOPMENT** Concept of Self-Development, Social Intelligence, Emotional Intelligence, Managing Time and Stress, Positive Human Qualities (Self-Efficacy, Empathy, Gratitude, Compassion, Forgiveness and Motivation), Personality Development Models – Johari Window, Transactional Analysis, Myers Briggs Type Indicator, Self-Awareness and Self-Development Exercises	**9**

Course Outcomes:	
1	Helps to distinguish between right and wrong in both personal and professional life
2	Students learn about their strengths, weaknesses, opportunities & threats and work enthusiastically to transform weaknesses into strengths and threats into opportunities

Reference Books:	
1	Murthy, C.S.V., "Business Ethics – Text and Cases", Himalaya Publishing House
2	Hartman, Laura P. and Chatterjee, Abha, "Business Ethics", Tata McGraw Hill
3	Rao, A.B., "Business Ethics and Professional Values", Excel Books
4	Velasquez, Manuel G., "Business Ethics – Concepts and Cases", Prentice Hall
5	Corey, G., Schneider, Corey M., and Callanan, P., "Issues and Ethics in the Helping Professions", Brooks/Cole
6	Hall, Calvin S., Lindzey, Dardner and Cambell, John B., "Theories of Personality", Hamilton Printing Company
7	Leary, M.R., "The Curse of Self: Self-awareness, Egotism and the Quality of Human Life", Oxford University Press

Course Name	**:**	**COMMUNICATION SKILLS (BASIC)**

Course Code	**:**	**HSS 102**
Credits	**:**	**2**
L T P	**:**	**1-0-2**

Course Objectives:
The main aim of the course is to build competence in English grammar and vocabulary and to enhance effective communication by developing Reading, Writing, Listening and Speaking skills of students.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**FUNDAMENTALS OF COMMUNICATION SKILLS** Scope and Significance of Communication Skills, Listening, Speaking, Reading and Writing	**3**
2	**WRITING SKILLS** Basics of Grammar – Placing of Subject and Verb, Parts of Speech, Uses of Tenses, Active-Passive, Narration	**3**
3	**VOCABULARY BUILDING AND WRITING** Word Formation & Synonyms, Antonyms, Words Often Confused, One-Word Substitutes, Idioms and Phrasal Verbs, Abbreviations of Scientific and Technical Words	**3**
4	**SPEAKING SKILLS** Introduction to Phonetic Sounds & Articulation, Word Accent, Rhythm and Intonation	**3**
5	**READING AND COMPREHENSION** Two comprehensive prose passages	**2**

List of Experiments:		**Number of Turns**
1	Introducing Oneself, Exercise on Parts of Speech & Exercise on Tense	**2**
2	Exercise on Agreement, Narration, Active Passive Voice & Dialogue Conversation	**2**
3	Exercise on Writing Skills and Listening Comprehension (Audio CD)	**2**
4	Practice of Phonemes, Word Accent, Intonation, JAM Session	**2**
5	Individual Presentation, Extempore and Picture Interpretation	**2**
6	Vocabulary Building Exercises (One Word Substitute, Synonyms, Antonyms, Words Often Confused etc.) & Group Discussion	**2**
7	Reading Comprehension & Organizational Correspondence and Debate	**2**

Course Outcomes:	
1	The students will be able to perform better in their academic and professional life.
2	The student will gain self-confidence with improved command over English.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"The Essence of Effective Communication", Ludlow R. and Panton F., Pubs: Prentice Hall.	1992
2	"A University Grammar of English", Quirk R. and Sidney G., 3rd Edition, Pubs: Pearson Education.	2008
3	"High School English Grammar", Wren and Martin, Pubs: S. Chand & Company Ltd.	2007
4	"Essentials of Business Communication", Guffrey M.E., 8th Edition, Pubs: South-Western College Publishing.	2009
5	"Technical Communication: Principles and Practice", Raman M. and Sharma S., 2nd Edition, Pubs: Oxford University Press.	2012
6	"Effective Business Communication", Rodrigues M.V., Pubs: Concept Publishing Company, Delhi.	2003
7	"English Vocabulary in Use", McCarthy M. and Felicity O' Dell, 2nd Edition, Pubs:	2010

	Cambridge University Press.	
8	"The Pronunciation of English", Jones D., Pubs: Universal Book Stall.	1992

Course Name	**:**	**COMMUNICATION SKILLS (ADVANCED)**
Course Code	**:**	**HSS 103**
Credits	**:**	**2**
L T P	**:**	**1-0-2**

Course Objectives:
The main aim of the course is to enhance communication skills of students for better performance in professional life and to improve their overall personality with the use of advanced techniques in speaking and writing and also to train them in using both verbal and non-verbal communication effectively.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO COMMUNICATION PROCESS** Scope, Significance, Types and Levels, Technical Communication, Tools of Effective Communication	**3**
2	**SPEAKING SKILLS AND PERSONALITY DEVELOPMENT** Interpersonal Communication, Oral Presentation, Body Language and Voice Modulation (Para linguistics and Non- Verbal), Negotiation and Persuasion, Group Discussion, Interview Techniques (Telephonic and Video Conferencing)	**6**
3	**ADVANCED Technical Writing** Job Application, CV Writing, Business Letters, Memos, Minutes, Notices, Report Writing & Structure, E-mail Etiquette, Blog Writing	**4**
4	**COMMUNICATION AND MEDIA** Social and Political Context of Communication, Recent Developments in Media	**1**

List of Experiments:		**Number of Turns**
1	**ORGANIZATIONAL COMMUNICATION** Verbal and Non-Verbal Communication at different levels of organization, Role Play, Case Studies	**2**
2	**SPEAKING TECHNIQUES** Mock Interviews, Participation in Group Discussions, Making and Presenting Power Point	**4**
3	**STANDARD ENGLISH & PRACTICE SESSION** Intonation and Pronunciation, Exposure to Standard English, Sounds, Stress and Rhythm, Comprehension on British and American English	**4**
4	**PRACTICE ON TECHNICAL WRITING** Writing Letters, Memos, Minutes, CV, Job Applications, Reports and e-mails	**4**

Course Outcomes:	
1	The students will gain proficiency in English language for both professional and personal life.
2	The students will learn technical aspects of communication for better performance in extra-curricular activities, recruitment process and prospective jobs.
3	The students will be able to refine their personality through a grip over advanced techniques of language.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**

1	"Effective Technical Communication", Rizvi M.A., 5th Reprint, Pubs: McGraw Hill Education (India).	2007
2	"Technical Communication: Principles and Practice", Raman M. and Sharma, S., 2nd Edition, Pubs: Oxford University Press.	2012
3	"Business Communication Today", Bovee C.L. and Thill J.V., 9th Edition, Pubs: Pearson Education Asia, New Delhi.	2009
4	"Business Correspondence and Report Writing", Sharma R.C. and Mohan K., Pubs: McGraw Hill	1994
5	"Communication for Professional Engineers", Scott B., 2nd Edition, Pubs: Thomas Teleford Ltd.	1997
6	"Handbook for Technical Writing", McMurrey D.A. and Buckley J., Pubs: Cengage Learning.	2012
7	"Student Activities for taking charge of your Career Direction and Job Search", Lock R., 3rd Edition, Pubs: Cole Publishing	1996
8	"The Definitive Book of Body Language", Pease A. and Pease B., Pubs: Manjul Publishing House Pvt. Ltd.	2005

Course Name	**:**	**ECONOMICS**
Course Code	**:**	**HSS 201**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of this course is to make students understand how society manages its scarce resources for achieving maximum satisfaction and to make them learn about economic aspects related to a consumer, firm, market and economy.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ECONOMICS** Nature of Economics, Economic Thoughts, Economic Activities, Relationship of Economics with other Social Sciences and Engineering	**3**
2	**THEORY OF CONSUMER BEHAVIOUR** Demand: Types, Law of Demand, Demand Supply Curve, Determinants of Demand and Change in Demand (Movement of Demand and Shift of Demand) with Case Studies Elasticity of Demand: Nature, Degrees, Types, Factors Affecting Elasticity of Demand and its Application in present scenario Laws of Consumption: Concept and Applicability of Law of Diminishing Marginal Utility and Law of Equi-Marginal Utility	**9**
3	**THEORY OF PRODUCTION AND COST** Cost: Concept and Types Production: Concept, Scale of Production, Law of Variable Proportion Returns to Factor and Returns to Scale: Causes and Implications Economies and Diseconomies of Scale: Concept and Types Relevance of Production and Cost Concept in present context	**5**
4	**THEORY OF MARKET** Market: Concept and Types (Perfect Competition, Monopoly and Monopolistic Competition), Nature and Relevance of different Markets in present scenario – Case Study	**5**
5	**BASIC CONCEPTS OF MACRO ECONOMICS** National Income: Concept and Measurement Methods, Determination of Equilibrium of Income	**6**

	Inflation: Concept, Causes and Effect of Inflation, Measures to Control Inflation, Case Study on Impact of Inflation	

Course Outcomes:	
1	The students are expected to apply engineering knowledge to maximize profit, satisfaction and welfare.
2	The students are able to identify the forces that affect the economy.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Modern Economics", Ahuja H. L., Pubs: Sultan Chand and Co. Ltd, New Delhi.	2012
2	"Economics For Engineers", Gupta M. L. and Gupta S.P., Pubs: ESS PEE Publications.	
3	"Business Economics", Ahuja H. L., Pubs: Sultan Chand and Co. Ltd, New Delhi.	2010
4	"Macro Economic Theory", Jhingan M.L., Pubs: Konark Publisher Pvt. Ltd., New Delhi.	1986
5	"Principles of Microeconomics", Stiglitz J.E. and Walsh C.E., 4th Edition, Pubs: W.W. Norton & Company.	2006
6	"Principles of Macroeconomics", Stiglitz J.E. and Walsh C.E., 4th Edition, Pubs: W.W. Norton & Company.	2006
7	"Principles of Economics", Mankiw N.G., 7th Edition, Pubs: Cengage Learning	2014
8	"Economics", Samuelson P.A. and Nordhaus W.D., 18th Edition, Pubs: McGraw Hill.	2004

Course Name	**:**	**PSYCHOLOGY**
Course Code	**:**	**HSS 202**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of the course is to provide knowledge and understanding about important concepts in Psychology which will help the students in learning the applications of principles of psychology in personal and professional life.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO PSYCHOLOGY** Concept, Nature and Scope Methods of Studying Human Behaviour – Introspection Method, Observation Method, Experimental Method, Case History Method, Survey Method, Psychological Test Use Relevance of these Methods in present context	**4**
2	**INTELLIGENCE** Concept and Determinants of Intelligence Theories of Intelligence and its Application: Spearman, Thurston, Guilford.	**4**
3	**PERSONALITY** Personality: Concept, Determinants of Personality, Trait Paradigm (Eysenck), Psychodynamic Paradigm (Freud), Measurement of Personality – Self Report Measures (EPQ), Projective Measures (TAT), Hypothetical Measurement of Personality	**4**
4	**MENTAL HEALTH AND STRESS** Mental Health: Concept and Factors Affecting Mental Health Stress: Nature, Rections to Stress, Outcomes of Stress, Stress Management Case Study	**4**

5	**LEARNING AND MEMORY** Learning: Concept, Reinforcement Principle and Learning, Managerial Implications Memory: Concept, Long Term Memory, Short Term Memory, Episodic Memory, Methods to Improve Memory	**3**
6	**MOTIVATION** Nature and Types of Motivation: Extrinsic and Intrinsic Theories of Motivation and its Application: Humanistic and Need Theories Factors Affecting Motivation	**3**
7	**GROUP BEHAVIOUR AND DYNAMICS** Concept and Importance, Types of Groups, Group Development, Group Performance Factors, Conflict: Nature, Conflict Resolution, Case Study	**4**
8	**LEADERSHIP** Leadership: Nature and Importance, Leadership Styles: Authoritarian, Democratic, Paternalistic, Laissez faire, Transactional, Transformational, Case Study	**2**

Course Outcomes:	
1	The students will learn the causes and dynamics of human behavior.
2	The students will be able to apply psychological principles to enhance their personal and professional life.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Psychology", Ciccarelli S.K. and Meyer G.E., Pubs: Pearson India.	2007
2	"Introduction to Psychology", Morgan C.T., Weiss J.R., King R.A. and Schopler J., 7th Edition, Pubs: McGraw-Hill Education.	2004
3	"An Introduction to Psychology", Mangal S.K., 1st Edition, Pubs: Sterling Publishers Pvt. Ltd., New Delhi.	2009
4	"Fundamentals of Social Psychology", Baron R.A., Branscombe N.R., Byrne D. and Bhardwaj G., 1st Edition, Pubs: Pearson India.	2011
5	"Organizational Behaviour", Parikh M. and Gupta R., Pubs: McGraw Hill Education.	2010
6	"Organizational Behavior", Robbins S.P., Pubs: Prentice Hall of India.	2003

Course Name	**:**	**SOCIOLOGY**	
Course Code	**:**	**HSS 203**	
Credits	**:**	**3**	
L T P	**:**	**2-1-0**	

Course Objectives:
The main aim of the course is to make the students understand the role of theory in social sciences and to explain them how social problems interact and react with the larger society. This course also intends to make them learn whether the problem is evaluated on the macro or micro perspective and their cause and effect patterns.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO SOCIOLOGY** Sociology as a Science, Impact of Industrial and French Revolution on the Emergence of Sociology, Contribution of Karl Marx, Emile Durkheim, Max Weber, Alwin Toeffler to Sociology and its Application in present scenario, Relevance of Sociology for Engineering	**5**
2	**BASIC CONCEPTS** Society, Association, Institution, Culture Relativism, Social Structure, Social System,	**2**

	Socialization, Competition, Conflict, Accommodation, Social Mobility	
3	**SOCIETY AND ECONOMY** Evolution of Society: Primitive, Agrarian, Industrial and Post-Industrial, Economic Systems of Simple and Complex Societies, Sociological Dimensions of Economic Life, Market (free) Economy and Controlled (planned) Economy	**4**
4	**INDUSTRIAL SOCIOLOGY** Nature and Scope of Industrial Sociology, Pre-Conditions and Consequences of Industrialization, Impact of Automation and Industrialization on Society with Case Study	**3**
5	**SCIENCE AND TECHNOLOGY** Ethos of Science and Social Responsibility of Science	**2**
6	**SOCIAL CHANGE** Theories of Change and its Application to Sociology, Factors of Change, Directed Social Change, Social Policy and Social Development, Social Cost Benefit Analysis, Role of Engineers in Development	**4**
7	**INDIAN SOCIETY** Traditional Hindu Social Organization, Caste System, Agrarian Society in India, Social Consequences of Land Reforms and Green Revolution, Working of the Democratic Political System in a Traditional Society, Problem of Education in India, Gender Discrimination, Economic Reforms: Liberalization, Privatization and Globalization, Strategies for Development in India, Case Studies	**6**
8	**SOCIAL PROBLEMS** Concept of AIDS, Alcoholism, Drug Addiction, Corruption with Case Study	**2**

Course Outcomes:	
1	The students will be able to identify the function and application of sociology theory in social sciences.
2	The students will be able to understand how social class affects individual life chances.
3	The students will learn about social structure and how it shapes and influences social interactions.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Sociology: Themes and Perspective", Haralambos M. and Holborn M., Pubs: Collins Educational Publications.	2008
2	"Sociology of Indian Society", Rao C.N.S., 2nd Edition, Pubs: Sultan Chand and Co., New Delhi.	2004
3	"Introduction to Sociology", Bhushan V. and Sachdeva D.R., Pubs: Kitab Mahal Publications.	2002
4	"An Introduction to Sociology", Dassgupta S. and Saha P., Pubs: Dorling Kindersley (India) Pvt. Ltd.	2012
5	"Social Change in Modern India", Srinivas M.N., 1st Edition, Pubs: Orient Longman.	2010
6	"Sociology and Modern Social Problems", Ellwood C.A., Pubs: Bastian Books.	2008
7	"Industrial Sociology", Singh N., 1st Edition, Pubs: McGraw Hill Education (India).	2012
8	"Society in India: Concepts, Theories and Recent Trends", Ahuja R., 1st Edition, Pubs: Rawat Publications.	2011

Course Name	**:**	**FRENCH**
Course Code	**:**	**HSS 204**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:

The main aim of this course is to introduce students with basics of a foreign language and make them learn how to communicate in a new language.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	Introductions: introduce yourself or someone else	**2**
2	Greetings	**2**
3	Alphabet / numbers	**3**
4	Communication in a class	**3**
5	Asking and answering basic questions: name – age – nationality – profession – family, friends, acquaintances	**3**
6	Giving the date / day / season / time / frequency of an event	**2**
7	Locating a place / describing a city or a locality / giving information about one's region, city or country	**4**
8	Expressing quantities	**2**
9	Expressing one's preferences / talk about one's leisure time activities	**3**
10	Describing a person / talking about his/her nature	**4**

Course Outcomes:	
1	The students will be able to express themselves in the foreign language.
2	The students will be able to make use of this language in their professional life in the globalized world.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Learn French Through English in 30 Days", Chopra B., 1st Edition, Pubs: Diamond Books.	2009
2	"Complete French", Graham G., Pubs: Hodder & Stoughton.	2012
3	"French Made Easy", Verma R., 1st Edition, Pubs: Goodwill Publishing House, New Delhi.	2012
4	"Learn French for Beginners", Schell R., Pubs: Maanu Graphics.	
5	"French Made Easy", Khan F., Pubs: Lotus Press.	2010
6	"French Course Grammar", Bertenshaw T.H., 1st Edition, Pubs: Orient Blackswan.	1998

Course Name	**:**	**PRINCIPLES OF MANAGEMENT**
Course Code	**:**	**HSM 401**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of this course is to make students understand the management process and principles along with its application in practical life and to help them manage different jobs and situations with the help of management functions.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO MANAGEMENT** Nature of Management: Art or Science, Principles and Functions of Management	**3**
2	**EVOLUTION OF MANAGEMENT THOUGHT** Classical Theories: Bureaucratic, Scientific and Administrative Approach	**6**

	Neo-Classical Theories: Human Relations and Human Behaviour Approach Modern Theories of Management Relevance of Management Thought in present scenario – Management Cases	
3	**PLANNING** Nature of Planning, Planning Process, Application of Planning Process in a Hypothetical Situation, Types of Planning, Types of Plans, Management by Objective (MBO)	**4**
4	**ORGANIZING** Concept of Organization, Departmentation, Forms of Organization Structure Analysis of Organization Structure – Case Studies Hypothetical Formation of an Organization	**4**
5	**STAFFING** Human Resource Planning: HRP Process, Job Analysis: Job Description, Job Specifications and Used of Job Analysis Recruitment: Sources and Methods Selection: Selection Process, Role Playing and Case Study on Selection Tests and Interviews Training and Development: Techniques, Performance Appraisal: Methods Case Study on Staffing Practices	**6**
6	**DIRECTING** Concept, Leadership: Importance and Styles, Motivation: Theories and their relevance in present scenario, Communication: Process, Types and Barriers of Communication Management Game on Leadership, Motivation and Communication	**3**
7	**CONTROLLING** Nature and Process of Controlling, Requirements for Effective Controlling	**2**

Course Outcomes:	
1	The students will be able to apply management concepts and principles in daily life and thus, will be able to manage things efficiently and effectively.
2	The students will learn how to get work done easily by using management knowledge and functions.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Principles and Practices of Management", Rao V.S.P. and Narayana P.S., Pubs: Konark Publishers.	1987
2	"Principles & Practice of Management", Prasad L.M., 8th Edition, Pubs: Sultan Chand & Sons.	2012
3	"Essentials of Management: International and Leadership Perspective", Weihrich H. and Koontz H., 9th Edition, Pubs: McGraw Hill.	2012
4	"The New Era of Management", Daft R.L., 11th Edition, Pubs: Cengage Learning.	2014
5	"Management: Text and Cases", Rao V.S.P. and Krishna V.H., Pubs: Excel Books.	2008
6	"Fundamentals of Management: Essential Concepts and Applications", Robbins S.P, DeCenzo D.A., Bhattacharya S. and Agarwal M.N., 6th Edition, Pubs: Pearson India.	2009

Course Name	**:**	**BUSINESS ENVIRONMENT AND BUSINESS LAWS**
Course Code	**:**	**HSM 402**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:

The main aim of this course is to make students understand different types of environment influencing business decisions and to provide knowledge about different laws that needs to be followed for initiating and managing business.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO BUSINESS** Scope and Characteristics of Business, Classification of Business Activities Forms of Ownership of Business: Sole Proprietorship, Partnership and Company	**5**
2	**BUSINESS ENVIRONMENT** Internal Environment: Concept and Elements (Value System, Vision Mission Objectives, Management Structure, Human Resources, Company Image etc.) SWOT Analysis: Concept and Case Study External Environment: Micro Environment (Suppliers, Customers, Competitors, Market Intermediaries etc.) and Macro Environment – PESTEL Analysis (Political, Economic, Social, Technological, Ecological and Legal), Case Study on Impact of Environment on Business	**7**
3	**GLOBALIZATION** Concept, Pros and Cons of Globalization, Impact of Global Environment on Business Globalization of Company – Case Study	**4**
4	**CORPORATE SOCIAL RESPONSIBILITY** Concept, Social Responsibility towards different stakeholders, Rationale for CSR CSR – Case Studies	**2**
5	**CORPORATE GOVERNANCE** Concept, Elements and Essentials of Good Governance	**3**
6	**CONTRACT LAW** Concept, Types and Essentials Elements of Contract	**3**
7	**PARTNERSHIP LAW** Nature of Partnership, Provisions of Partnership Act, Issues Related to Partnership Firm, Hypothetical Formation of a Partnership Firm	**2**
8	**COMPANY LAW** Nature of Company, Provisions of Company Act, Issues Related to Incorporation of Company, Hypothetical Formation of a Company	**2**

Course Outcomes:	
1	The students will be able to analyze the impact of environment on business and formulate appropriate business strategies to compete in the competitive world.
2	The students will learn how companies follow corporate governance and social responsibility practices along with fulfilling economic objectives.
3	The students will gain knowledge about application and implementation of various business laws in practice.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Business Environment: Text and Cases", Cherunilam F., 22nd Edition, Pubs: Himalaya Publications.	2013
2	"Legal Aspects of Business", Pathak A., 5th Edition, Pubs: McGraw Hill Education.	2013
3	"Essential of Business Environment: Text, Cases and Exercises", Aswathappa K., 11th Edition, Pubs: Himalaya Publication.	2011
4	"Business Law Including Company Law", Gulshan S.S. and Kapoor G.K., 15th Edition, Pubs: New Age International (p) Ltd.	2011

5	"Business Law and Corporate Laws", Tulsian P.C., 1st Edition, Pubs: Sultan Chand Publishing.	2011
6	"Fundamentals of Business Organization & Management", Bhushan Y.K., 19th Edition, Pubs: Sultan Chand & Sons.	2013
7	"Corporate Governance: Principles, Policies and Practices", Fernando A.C., 2nd Edition, Pubs: Pearson India.	2011

Course Name	**:**	**ENTREPRENEURSHIP AND PROJECT MANAGEMENT**
Course Code	**:**	**HSM 403**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of this course is to make prospective engineers familiar with the concept of entrepreneurship and MSMEs and to provide knowledge about different aspects to be considered while formulating the business plan for a new entrepreneurial venture. This course also intends to create awareness among students about financial and marketing functions that is required for a new venture.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ENTREPRENEURSHIP** Concept of Entrepreneurship, Characteristics and Functions of Entrepreneur Forms of Ownership of Business, Factors Affecting Entrepreneurship Case Studies of Entrepreneurs	**6**
2	**WOMEN ENTREPRENEURSHIP** Nature of Women Entrepreneurship, Problems of Women Entrepreneurs, Institutional Initiatives for Promotion of Women Entrepreneurs	**2**
3	**MICRO, SMALL AND MEDIUM ENTERPRISES (MSMES)** Concept of MSMEs, Schemes of MSMEs Functions of Entrepreneurial Development Programmes (EDPs)	**2**
4	**PROJECT IDENTIFICATION** Idea Generation, Project Life Cycle, Concept of SWOT Analysis SWOT Analysis of Selected Project	**2**
5	**PROJECT PLANNING AND FORMULATION** Elements of Project Formulation: Product, Technical (Location, Scale, Technology, Production Process, Layout, Manpower, Resources etc.), Market, Finance and Economic Aspects Feasibility Analysis: Financial Viability and Profitability, and Socio-Economic Desirability	**7**
6	**PROJECT REPORT** Formulation of Business Plan and Project Report, Hypothetical Example of a Real-Life Project	**2**
7	**FINANCE AND MARKETING FUNCTION** Concept of Finance, Finance Related Terminologies, Sources of Finance, Cost Estimations Marketing Mix: Product, Place, Price, Promotion, People, Process and Physical Evidence Marketing Segmentation Targeting and Positioning	**5**
8	**DISCUSSIONS ON ADDITIONAL READING** (any one of the following in the semester) - The New Age Entrepreneurs - The $100 Startup: Fire your Boss, Do what you Love and Work Better to Live More - A Guide to Entrepreneurship - Dhandha: How Gujaratis Do Business - Rokda: How Baniyas Do Business	**2**

	- Take Me Home - Business Families of Ludhiana	

Course Outcomes:	
1	The students will be able to apply engineering knowledge effectively in the field of entrepreneurship development.
2	The students can make effective use of entrepreneurial knowledge to start and manage their venture.
3	The students will learn to check the feasibility of a new project to maintain its long run sustainability.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Dynamics of Entrepreneurial Development & Management", Desai V., 5th Edition, Pubs: Himalaya Publishing House.	
2	"Projects: Planning, Analysis, Selection, Financing, Implementation and Review", Chandra P., 8th Edition, Pubs: McGraw-Hill Education (India).	2014
3	"Entrepreneur's Toolkit", Harvard Business School, Pubs: Harvard University Press.	2004
4	"Entrepreneurship", Hisrich R.D., Peters M.P. and Shepherd D.A., Pubs: McGraw Hill Education.	2006
5	"Essentials of Project Management", Ramakrishna K, Pubs: PHI Learning.	
6	"Entrepreneurship", Roy R., 2nd Edition, Pubs: Oxford University Press	2011
7	"Entrepreneurship Development in India", Gupta C.B. and Srinivasan N.P., Pubs: Sultan Chand and Sons.	2013

Course Name	**:**	**FINANCIAL MANAGEMENT**
Course Code	**:**	**HSM 404**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of this course is to make students learn different financial decisions i.e. investing, financing and dividend, required to be taken by a company and provide knowledge about the functioning of the financial system (financial markets, financial institutions, financial services and financial instruments) of the country.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO FINANCIAL MANAGEMENT** Concept of Finance, Terminology Related to Finance, Financial Decisions, Factors Affecting Financial Decisions, Risk-Return Trade-Off	**3**
2	**FINANCIAL SYSTEM** Concept and Role of Financial System in Indian Economy	**2**
3	**FINANCIAL MARKETS AND INSTRUMENTS** Concept and Relevance of Money Market and Capital Market Money Market Instruments: Call Money, Treasury Bills, Commercial Papers, Certificate of Deposits Capital Market Instruments: Equity Shares, Preference Shares and Debentures Hypothetical Trading in Financial Markets	**5**
4	**FINANCIAL SERVICES** Nature and Functions of Financial Services: Merchant Banking, Mutual Funds, Factoring, Forfaiting, Credit Rating	**6**

	Case Study on Financial Services	
5	**FINANCIAL INSTITUTIONS** Nature and Functions of Financial Institutions: Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Discount and Finance House of India (DFHI)	**2**
6	**LONG TERM INVESTMENT DECISIONS** Capital Budgeting: Concept, Importance, Factors Techniques/Methods with Numerical Applications (Pay Back Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return and Profitability Index), Case Study	**3**
7	**SHORT TERM INVESTMENT DECISIONS** Working Capital: Nature, Type and Factors Affecting the Requirement of Working Capital, Case Study	**2**
8	**FINANCING DECISIONS** Capital Structure: Essentials and Approaches of Capital Structure Sources of Finance (long-term and short-term), Financial Leverage: Concept and Numerical Application, Case Study	**3**
9	**DIVIDEND DECISIONS** Types of Dividend, Dividend Policy: Nature and Factors Affecting Dividend Policy, Case Study	**2**

Course Outcomes:	
1	The students will learn to make best combination of financial decisions by considering risk and return trade-off.
2	The students will identify how business can gain maximum through the financial system.
3	The students will understand how to manage funds effectively so as to maximize returns.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Financial Management", Shah P., 2nd Edition, Pubs: Dreamtech Press	2009
2	"Financial Markets and Services", Gordon E. and Natarajan K., 3rd Edition, Pubs: Himalaya Publishing House.	2006
3	"Financial Management: Theory and Practice", Chandra P., 8th Edition, Pubs: McGraw Hill Education (India).	2012
4	"Financial Management", Pandey I.M., 10th Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2010
5	"Cases in Financial Management", Pandey I.M. and Bhat R., 3rd Edition, Pubs: McGraw Hill Education (India).	2012
6	"Financial Institutions and Markets: Structure, Growth and Innovations", Bhole L.M. and Mahakud J., 5th Edition, Pubs: McGraw Hill Education (India).	2009
7	"The Indian Financial System: Markets, Institutions and Services", Pathak B.V., 3rd Edition, Pubs: Pearson India.	2010
8	"Financial Management and Policy", Horne J.C.V. and Dhamija S., 12th Edition, Pubs: Pearson India.	2011

Course Name	**:**	**MARKETING MANAGEMENT**
Course Code	**:**	**HSM 405**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:

The main aim of this course is to make students understand about the marketing concepts to be applied in real life and the marketing process for delivering value to customers.

Total No. of Lectures –28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO MARKETING** Concepts, Role, Scope and Types of Marketing, Case Study on Marketing Management	**3**
2	**MARKETING RESEARCH** Scope and Process of Marketing Research, Hypothetical Marketing Research Analysis	**3**
3	**CONSUMER AND BUSINESS MARKETS** Types of Markets, Building Customer Value Consumer and Business Buying Behaviour: Factors Influencing Behaviour and Buying Decision Process	**4**
4	**SELECTION OF MARKETS** Segmentation: Factors and Bases, Targeting and Positioning Preparation of STP of Selected Product	**3**
5	**MARKETING MIX** 7 P's of Marketing Mix: Product, Price, Physical Distribution, Promotion, People, Process and Physical Evidence Formulation of Marketing Mix of Selected Product	**3**
6	**PRODUCT DECISIONS** Product (Good or Service) Characteristics, Product Life-Cycle, Packaging and Branding, Product Development and Management	**3**
7	**PRICING DECISIONS** Pricing Policies and Strategies, Factors Influencing Pricing	**3**
8	**PHYSICAL DISTRIBUTION DECISIONS** Marketing Channels, Channel Players, Physical Distribution, Managing Distribution, Analysis of Supply Chain Management – Case Studies	**3**
9	**PROMOTION DECISIONS** Nature of Promotion Decisions, Managing Mass Communication and Personal Communication Analysis of Promotional Strategies – Case Studies	**3**

Course Outcomes:	
1	The students will learn how to market goods and services effectively to different segments so as to deliver value to customers.
2	The students will be able to formulate marketing mix and marketing strategies for different products and different sets of customers.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Marketing Management: Concepts, Cases, Challenges and Trends", Govindarajan M, 2nd Edition, Pubs: PHI Learning.	2009
2	"Marketing Management", Kotler P., Keller K.L., Koshy A. and Jha M., 14th Edition, Pubs: Pearson India.	2012
3	"Marketing Concepts and Strategies", Dibb S., Simkin L., Pride W.M. and Ferrell O.C., Pubs: Cengage Learning.	2012
4	"Marketing Management", Kumar A. and Meenakshi N., 2nd Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2011
5	"Marketing Management", Saxena R., 4th Edition, Pubs: McGraw Hill Education (India).	2013
6	"Marketing: Managerial Introduction", Gandhi J.C., 1st Edition, Pubs: McGraw Hill	1987

	Education.	
7	"Marketing", Etzel M.J., Walker B.J., Stanton W.J. and Pandit A., 14th Edition, Pubs: McGraw Hill Education (India).	2010
8	"Super Marketwala: Secrets to Winning Consumer India", Mall D., 1st Edition, Pubs: Random House India.	2014

Course Name	**:**	**HUMAN RESOURCE MANAGEMENT**
Course Code	**:**	**HSM 406**
Credits	**:**	**3**
L T P	**:**	**2-1-0**

Course Objectives:
The main aim of this course is to provide an overview of HRM, keeping the Indian business scenario in the background and to acquaint the students with the strategic role of HRM in managing an organization.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT** HRM: Nature, Scope, Functions, HRM Practices and Problems in India with Case Studies	**4**
2	**HUMAN RESOURCE PLANNING (HRP)** Concept and Process of HRP, Factors Affecting HRP	**3**
3	**JOB ANALYSIS AND DESIGNING** Uses and Process of Job Analysis, Job Description and Job Specification: Features and Hypothetical Formulation, Job Designing: Job Enrichment, Job Enlargement	**3**
4	**RECRUITMENT AND SELECTION** Recruitment: Sources and Methods Selection: Selection Process, Selection Tests, Types and Nature of Interviews Role Playing and Case Study on Selection Process, Tests and Interview	**4**
5	**INDUCTION AND INTERNAL MOBILITY** Induction Programme, Need and Scope of Internal Mobility: Transfer, Promotion, Demotion	**3**
6	**TRAINING AND DEVELOPMENT** Training: Need and Methods, Management Development: Need, Methods and Management Development Programme HRM Games for Development of Employees	**4**
7	**PERFORMANCE APPRAISAL AND COMPENSATION** Nature and Methods of Performance Appraisal, Hypothetical Performance Appraisal Compensation: Financial and Non-Financial Benefits	**4**
8	**EMPLOYEE HEALTH AND SAFETY** Concept, Issues related to Health and Safety, Workplace Health Hazards	**3**

Course Outcomes:	
1	The students will develop the ability to solve problems in area of HRM in organizations.
2	The students will become aware of latest developments in HRM practices which are essential for effective management in organization.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Human Resource Management: Text and Cases", Rao V.S.P., Pubs: Excel Books.	2002

2	"Human Resource Management", Dessler G. and Varkkey B., 12th Edition, Pubs: Pearson India.	2011
3	"Human Resource Management: Text and Cases", Aswathappa K., 7th Edition, Pubs: McGraw Hill Education (India).	2013
4	"Human Resource Management: Text and Cases", Gupta C.B., 14th Edition, Pubs: Sultan Chand and Sons.	2012
5	"Human Resource Management: Text and Cases", Bedi S.P.S. and Ghai R.K., Pubs: Bharti Publications.	2012
6	"Human Resource Management Applications: Cases, Exercises, Incidents and Skill Builders", Fottler M.D., McAfee R.B. and Nkomo S.M., 7th Edition, Pubs: Cengage Learning.	2013

ENGINEERING SCIENCE COURSES

Course Name	**:**	**COMPUTER PROGRAMMING (BASIC)**
Course Code	**:**	**CSN104**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
To develop logical skills so that students should be able to solve basic computing problems. To learn the syntax and usage of C programming constructs.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO PROGRAMMING** Evolution of languages: Machine languages, Assembly languages, High-level languages. Software requirements for programming: System softwares like operating system, compiler, linker, loader; Application programs like editor. Algorithm, specification of algorithm. Flowcharts.	4
2	**PROGRAMMING IN C** Data types in C, Formatted input-output for printing integer, floating point numbers, characters and strings.	2
3	**OPERATORS AND EXPRESSION** Expressions in C and their evaluation. Precedence and associativity rules. Operators: arithmetic operators, relational operators, logical operations, bitwise operators, miscellaneous operators.	6
4	**STATEMENTS** Decision making structures: if, if-else, nested if and if-else, switch. Control structures: for, while, do-while. Role of statements like break, continue, goto.	6
5	**ARRAYS** Concept and use of arrays, declaration and usage of arrays, 2-dimensional arrays.	6
6	**FUNCTIONS** Advantage of modularizing C program into functions, function definition and function invocation. Methods of passing parameters to a function: call-by-value, call-by-reference; Passing arrays to functions, Recursion, Library functions.	4
7	**POINTERS** Pointer declaration and initialization, constant pointers, pointers to constant objects, pointer arithmetic, relationship between pointer and arrays.	4
8	**SCOPE AND LIFETIMES** Scope and lifetime of a variable, storage classes: auto and typedef.	2
	USER-DEFINED DATA TYPES Structures- definition, declaration, use, accessing structure members directly or through pointer structure, structure having arrays and pointers as members, self referential structures, passing structures to functions. Unions: definition, declaration, use, accessing union members directly or through pointer structure.	6
	FILES Concepts of files and basic file operations.	2

Course Outcomes:	
1	The student will demonstrate proficiency in C programming language.

Text Books:	
1	Let Us C, Yashwant Kanetkar, BPB Publications
2	Programming in C: A practical approach, Ajay Mittal, Pearson Education

Reference Books:

1	The C programming language, Kernighan Ritchie, Pearson Education
2	Programming in ANSI C, Balaguruswamy, Tata McRaw Hill
3	Computing Fundamentals, Peter Nortan, Tata McRaw Hill

Course Name	**:**	**COMPUTER PROGRAMMING (ADVANCED)**
Course Code	**:**	**CSN105**
Credits	**:**	**4**
L T P	**:**	**3 0 2**

Course Objectives:
To develop logical skills so that students should be able to solve basic computing problems. To learn the syntax and usage of C programming constructs at advanced level.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO STRUCTURED PROGRAMMING** Introduction to topics: decision making, Iteration, functions: functions with variable number of arguments, multiple file programs, concept of linking.	6
2	**ARRAYS** Array declaration and use, Two-dimensional arrays and multi-dimensional arrays. Strings and Character arrays. Operations on arrays such as insertion, searching, sorting, merging.	6
3	**POINTERS** Pointer expression, pointer arithmetic, pointer to array, pointer to functions, dynamic memory allocation, dynamic allocation of arrays. Call functions through function pointers, Accessing members of arrays through pointers.	6
4	**PREPROCESSOR DIRECTIVES** Introduction, Various preprocessor directives, macros with and without arguments, conditional compilation.	6
5	**STRUCTURE, UNION, ENUMERATION AND BIT-FIELDS** Definition, declaration and initialization, structures containing arrays, array of structures, structure having structures, pointers to structures, self-referential structures, dynamic allocation of structures; Unions: Definition, declaration and initialization. Concepts of interrupts interrupt programming, enumerations and bit-fields.	8
6	**FILES** Concept of file, file operations, text mode and binary mode, command line arguments.	4
7	**INTRODUCTION TO OBJECT ORIENTED PROGRAMMING** Classes and objects, basic features of object oriented programming like encapsulation, abstraction, polymorphism, etc.	3
8	**APPLICATIONS** Projects related to the development of Terminate and Stay resident (TSRs), graphical applications, text-editors, etc.	3

Course Outcomes:	
1	The student will demonstrate proficiency in C programming language.

Text Books:	
1	Let Us C, Yashwant Kanetkar, BPB Publications
2	Programming in C: A practical approach, Ajay Mittal, Pearson Education

Reference Books:	
1	The C programming language, Kernighan Ritchie, Pearson Education
2	Programming in ANSI C, Balaguruswamy, Tata McRaw Hill

3	Computing Fundamentals, Peter Nortan, Tata McRaw Hill

Course Name	**:**	**ENGINEERING DRAWING**
Course Code	**:**	**ESC 101**
Credits	**:**	**4**
L T P	**:**	**2-0 -4**

Course Objectives:
At the end of this course, the student should be able to understand the basic concepts of Engineering Drawing. The student should be able to visualize and draw the two and three dimensional objects. The student should also be able to apply drafting softwares in various types of problems.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	Introduction to Engg. Graphics, System of Projections, Orthographic projections, Lettering, Dimensioning rules	2
2	Projections of points and lines, Projection of lines on different planes, Traces and true length of the lines	2
3	Projections of planes/laminae on reference planes, classification of Primary and secondary planes, examples	2
4	Classification of solids, Projections of solids on the basis of positions of the axis of various solids on reference planes	3
5	Sectioning of solids, True and apparent sections, sectioning on the basis of position of section planes	3
6	Developments of surfaces, Parallel line, Radial line and Triangulation methods of development of right and oblique solids	3
7	General introduction to Perspective projection, isometric views, Isometric lines & Axes, Four centre and off set method of drawing ellipse from circle, conversion of orthographic views to isometric views and vise-versa	3
8	Introduction to AutoCAD software for drawing of 2D projections, practical exercises on points, lines, planes and solids	10

List of Experiments:		**Number of Turns**
1	Exercises on projection of Points on drawing sheets	1
2	Exercises on projection of lines on drawing sheets	1
3	Exercises on projection of planes on drawing sheets	1
4	Exercises on projection of solids on drawing sheets	2
5	Exercises on sections of solids on drawing sheets	1
6	Exercises on Developments of surfaces and Isometric projections on drawing sheets	2
7	Practice of exercises on points and lines using AutoCAD software	1
8	Practice of exercises on planes using AutoCAD software	2
9	Practice of exercises on solids and developments using AutoCAD software	2
10	Practice of exercises on isometric projections using AutoCAD software	1

Course Outcomes: At the end of this course, the students will be able to:	
1	Understand the basic concepts of Engineering Graphics.
2	Visualize the actual objects and convert them in to readable drawings.
3	Understand the drawing standards, conventions and symbols that are in common usage.
4	Draw the common Engineering drawings using available drafting softwares.
5	Come up with innovative conceptual ideas by using Drafting softwares.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Engineering Drawing", P. S. Gill, S.K. Kataria & Sons	2012
2	"Engineering Drawing", D.A. Jolhe, Tata McGraw Hill	2010
3	"Engineering Graphics with Auto CAD", James Bethune, Prentice Hall, India	2003

Course Name	**:**	**FLUID MECHANICS**	
Course Code	**:**	**ESC102**	
Credits	**:**	**4**	
L T P	**:**	**3 0 2**	

Course Objectives:
To learn the basic concept of fluid mechanics. To understand the analytical method of solving fluid mechanics problem

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION** Fluids, Brief history of Fluid Mechanics, Properties of Fluid, Viscosity, Capillarity, Surface Tension, Compressibility, Normal and Shear Stresses in Fluid Flows, Regimes of Flow	4
2	**FLUID STATICS** Pascal's Law of measurement of pressure, Types of forces on a fluid system, manometers and gauges, forces on partially and fully submerged bodies including that on curved surfaces, Buoyancy, stability of floating bodies, centre of gravity, Metacentric height.	**6**
3	**KINEMATICS OF FLUID FLOW** Langrangian and Eulerian methods, description of properties in a moving fluid, local and convective acceleration, Streamlines, Path lines, Streak lines, Laplace equation, Stream function, velocity potential and flownets.	**4**
4	**DYNAMICS OF FLUID FLOW** Equation of conservation of mass, differential form of continuity equation. External forces, Euler's equation of motion, Bernoulli's equation, simple application to one dimensional flow, linear momentum and angular momentum, momentum theorem, moment of momentum theorem	**8**
5	**VISCOUS FLOW** Pressure gradient in steady uniform flow, flow between parallel plates, Qualitative aspects of viscous flows, Hagen-Poiseulli's flow, Transition from laminar to turbulent flow, turbulent flow in circular pipe, Navier Stokes equation (without derivation).	**5**
6	**FLOW THROUGH PIPES** Introduction, energy and hydraulics grade line, non-dimensional formulation of the pipe flow problem, head losses in pipes & pipe fittings, pipe in series & parallel, reservoir problem.	**5**
7	**DIMENSIONAL ANALYSIS AND SIMILITUDE** Buckingham's Theorem, non-dimensional groups, Geometric, Kinematic and Dynamic Similarity, Hydraulic Models.	**4**
8	**FLOW MEASUREMENT** Venturimeter, orifice meter, Pitot tube, Orifices, mouth pieces, notches, weirs, Current meter.	**6**

List of Experiments:

1	Flow Measurement by Orifice Meter
2	Flow Measurement by Venturimeter
3	Flow Measurement by V Notche
4	Computation of various coefficients involving in through orifice.
5	Determination of friction factors of pipes Minor losses in pipes
6	Determination of friction factors of pipes
7	Verification of Bernoulli's theorem
8	To determination of the metacentric height of a given vessel under unloaded condition.

Course Outcomes:	
1	To apply the learned techniques in real life problems related to fluid mechanics.

Text Books:	
1	G.L. Asawa, "Experimental Fluid Mechanics-Volume I" Nem Chand & Brothers
2	B. S. Kapoor, "Manual of Fluid Mechanics" Khanna Publishers
3	S. Singh, "Experiments in Fluid Mechanics-Second Edition" PHI Publications

Reference Books:	
1	Frank M. White, "Fluid Mechanics", McGraw Hill.
2	H. Rouse , "Elementary Mechanics of Fluids"
3	Streeter, V.L.,"Fluid Mechanics" McGraw Hill Co
4	Lewitt, E.H.,"Hydraulics and the Mechanics of Fluids" Pitman

Course Name	**:**	**INTRODUCTION TO MANUFACTURING**
Course Code	**:**	**ESC 103**
Credits	**:**	**4**
L T P	**:**	**2-0-4**

Course Objectives:
At the end of the course the students should be able to describe the properties of engineering materials and different manufacturing processes. The students should be able to select appropriate manufacturing process and manufacture a job in the different shops and areas of applications.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION** Classification of manufacturing processes, classification of engineering materials, comparison of material properties of metals, ceramics and plastics, crystal structures, strain hardening effects, stress-strain curves. Safety measures in workshop.	3
2	**MATERIALS AND HEAT TREATMENT** Objective of heat treatment, classification of heat treatment, annealing, normalizing, hardening & tempering, case hardening, carburizing, nitriding, flame hardening, induction hardening, applications of heat treatment.	4
3	**FOUNDRY** Pattern, properties of pattern material, types of pattern, cores. Types of sand, moulding sand ingredients. Types of moulding processes. Types of casting processes: sand casting, shell casting, investment casting and centrifugal casting. Casting defects & remedies. Case studies and applications.	4
4	**FORMING** Metal forming, types and applications, hot & cold working, forging, drawing, rolling and sheet metal operations.	3

5	**MACHINING** Metal removal processes, machines, single-point tool, cutting tool geometry, lathe - types, elements and main parts of lathe, drilling, milling and grinding machines. Applications.	3
6	**FINISHING** Surface finishing processes, principle and applications, lapping, honing, super finishing, polishing, buffing, electroplating, galvanizing.	2
7	**WELDING** Classification of welding processes, mechanism of arc formation, arc welding processes, gas welding, and resistance welding, principles and applications, welding defects, causes and remedies. Soldering and brazing. Applications and case studies in welding.	3
8	**PLASTICS MANUFACTURING** Types and properties of plastics, thermosetting and thermoplastic resins, elastomers. Fabrications of plastics, injection moulding, blow moulding, extrusion moulding etc.	2
9	**MODERN MANUFACTURING PROCESSES** Introduction, classification, electric discharge machining (EDM), electro chemical machining (ECM), laser beam machining (LBM) and Rapid Prototyping Techniques. Case studies on modern and hybrid manufacturing processes.	2
10	**CASE STUDIES** Considerations of selecting manufacturing processes for industrial products like compact disc, PCB and emerging technological applications.	2

List of Experiments:		**Number of Turns**
1	To prepare half lap T & L joint in the carpentry shop.	1
2	To prepare the pattern of half nut in carpentry shop.	1
3	To prepare cube from a piece of round bar in forging shop.	1
4	To study the lathe, milling, planer, and shaper operations.	1
5	To manufacture a multi-operational job on lathe/milling in the machining shop.	1
6	To prepare series and parallel wiring connections in the electrical shops.	1
7	To prepare the butt joint by SMAW in welding shop.	1
8	To prepare the mould of a given pattern in foundry shop.	1
9	To cast the prepared mould in foundry shop.	1
10	To prepare a square job in the fitting shop.	1
11	To prepare rectangular box in sheet-metal shops.	1
12	To prepare different joints in the sheet-metal shop.	1

Course Outcomes: By the end of this course, the students will be able to:	
1	Compare the properties of the engineering materials.
2	Select the appropriate manufacturing process for a given job/ application.
3	Identify the advantages and limitations of different manufacturing processes.
4	
5	

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Manufacturing Engineering and Technology", Serope Kalpakjian and Steven Schmid, Pearson Publications.	2009
2	"A Textbook of Production Technology: Manufacturing Processes", P. C. Sharma, S. Chand & Company Ltd.	2004
3	"Foundry, Forming and Welding", P.N. Rao, Tata M/C Graw Hill Publication.	2007
4	DeGarmo, Materials and Processes In Manufacturing, John Wiley & Sons	2011

Course Name	**:**	**THERMODYNAMICS**
Course Code	**:**	**ESC 201**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the student should be able to, Understand the basic principles of Thermodynamics and to give students a feel for how Thermodynamics is applied in Engineering practices.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**BASIC CONCEPTS :**Macroscopic and Microscopic Approach, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Thermodynamic Equilibrium, State, Path, Process, cycle, Quasi-static Process, Reversible and Irreversible Process, Working Substance. Thermodynamic Properties like Pressure, Volume and Temperature, Zeroth Law of Thermodynamics. Temperature Scales, Concept of Heat and work in Thermodynamics.	**8**
2	**FIRST LAW OF THERMODYNAMICS:** Joule's Paddle wheel Experiment; Mechanical Equivalent of Heat, First Law for a closed system undergoing a Cycle, First Law for a closed system undergoing a change of state. Different forms of stored Energy, Enthalpy, Energy of An isolated System, Perpetual Motion Machine of First kind.	**6**
3	**FIRST LAW APPLIED TO FLOW PROCESSES:** Flow Process and Control Volume, flow work, Steady and Unsteady Flow Process, Steady Flow Energy Equation, Engineering Applications of Steady Flow Energy Equation, Throttling Process, Flow Work and Non Flow work, Variable flow Processes, Limitation of First Law.	**5**
4	**SECOND and THIRD LAW OF THERMODYNAMICS:** Qualitative Difference between Heat and Work, Thermal Reservoir, Statements of 2nd Law by Max.Planck and Claussius, Equivalence between two statements, Energy Analysis of Heat Engine, Refrigerator and Heat Pump Reversibility and Irreversibility, Causes of Irreversibility Carnot Theorem, Carnot cycle, Absolute Thermodynamic Temperature, Scale, Efficiency of the Reversible Heat Engine, Equality of Ideal Gas Temperature and Kelvin Temperature.	**8**
5	**ENTROPY**: Classius Theorem, Classius Inequality and concept of Entropy, Entropy change in an Irreversible Process, Application of Entropy Principle, Entropy Transfer with Heat Flow, Entropy generation in closed and open System, Thermodynamics Equations relating properties of System, Reversible Adiabatic work in a Steady flow System. Entropy and direction, Entropy and disorder.	**5**
6	**PROPERTIES OF GASES AND GAS MIXTURE** : Equation of state of a gas, Properties of Mixture of gases, Internal Energy, Enthalpy and Specific heat of gas, mixtures, Entropy of gas Mixtures.	**3**
7	**STEAM GENERATORS:** Classification of steam generators, Boiler mountings and accessories. Principles and operations of steam accumulators. Description of Cochran, Locomotive, Lancashire, Babcock and Wilcox boiler, Modern high pressure boilers, Characteristics and advantages of high pressure boilers.	**7**
8	**BASIC CONCEPTS :**Macroscopic and Microscopic Approach, Concept of Continuum, Thermodynamic System, Surrounding and Boundary, Thermodynamic Equilibrium, State, Path, Process, cycle, Quasi-static Process, Reversible and Irreversible Process, Working Substance. Thermodynamic Properties like Pressure, Volume and Temperature, Zeroth Law of Thermodynamics. Temperature Scales, Concept of Heat and work in Thermodynamics.	**8**
9	**FIRST LAW OF THERMODYNAMICS:** Joule's Paddle wheel Experiment; Mechanical Equivalent of Heat, First Law for a closed system undergoing a Cycle, First Law for a closed system undergoing a change of state. Different forms of stored Energy, Enthalpy, Energy of An isolated System, Perpetual Motion Machine of First kind.	**6**

Course Outcomes:	
1	A fundamental understanding of various Laws of thermodynamics and their applications.
2	Understand the efficiencies of Heat Engines and other Engineering Devices.
3	Understand the working principles and applications of various types of steam generators.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	"Engineering Thermodynamics", Gordon Rogers & Yon Machew	2006
2	"Thermodynamics", Yunus Cengel and Mike Boles	2006
3	"Thermodynamics", Arora.	2005
4	"Engineering Thermodynamics", P.K. Nag	2010
5	"Thermo dynamics", Dr. D.S. Kumar	2012

Course Name	**:**	**ESSENTIALS OF INFORMATION TECHNOLOGY**
Course Code	**:**	**ESC202**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
The students should be able to understand the concepts of networking, RBMS, Software Engineering and Web Technology.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**NETWORKING AND COMMUNICATION** Introduction to digital communication: Signal propagation, signal types, signal parameters, Channel effect on transmission. Physical layer characterization: Types of transmission media, physical layer interfaces. Data transmission mechanisms: Communication modes, transmission modes, synchronization, introduction to packet switching, multiplexing, error control methods. Network architectures: Introduction to computer networks, Network topologies, Types of networks: LAN, WAN, MAN, layered network model. Internet Protocols: Introduction, Transport layer protocols: TCP, UDP. Application layer protocols: DNS, SMTP, POP, IMAP. Practical aspects of networking.	**12**
2	**RELATIONAL DATABASE MANAGEMENT SYSTEM** RDBMS- data processing – the database technology – data models- ER modeling concept – notations – converting ER diagram into relational schema - Logical database design - normalization (1NF, 2NF and 3NF). SQL – DDL statements – DML statements – DCL statements - Joins - Sub queries – Views - Database design Issues – SQL fine tuning.	**10**
3	**WEB TECHNOLOGIES AND INTRODUCTION TO USER INTERFACE AND WEB TECHNOLOGIES :** web fundamentals – types web content – HTML – text formatting tags in HTML – HTML form elements - and tags - text formatting using CSS : embedded CSS, inline CSS and external CSS – JavaScript and its features.	**10**
4	**SOFTWARE ENGINEERING** Software Engineering : Definition – role of software and software crisis – SDLC models : waterfall model, incremental model and spiral model – software testing – static & dynamic testing – types testing : unit testing, integration testing, system testing, performance testing and regression testing.	**10**

Course Outcomes:

1	Document artifacts using common quality standards
2	Design simple data store using RDBMS concepts

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Thomas Powell, HTML and CSS: The complete reference, 5th Edition	2010
2	Henry F Korth, Abraham Silberschatz, "Database system concepts", Second ed., McGraw-Hill International editions, Computer Science series	2006
3	A. Tanenbaum, Computer Networks, 5th Edition	2010
4	William Stallings, Data and Computer Communications, 10th Edition	2013

Course Name	**:**	**MATERIALS SCIENCE**
Course Code	**:**	**ESC 203**
Credits	**:**	**04**
L T P	**:**	**3 1 0**

Course Objectives:
The student will be able to know the concepts of atomic bonding, crystal structures, imperfections, diffusion, mechanical properties, electron energy, and dislocations as related to processing and performance of engineering material

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION** Historical perspective, Scope of Materials Science and engineering, Geometry of crystals, Structure determination by X-Ray Diffraction, Atomic structure and chemical bonding, Structure of solids	10
2	**IMPERFECTIONS IN ATOMIC AND IONIC ARRANGEMENTS** Point defects, Dislocations, Significance of Dislocations, Influence of Crystal structure, Surface defects, Importance of defects	4
3	**PHASE DIAGRAMS** Phase rule, Single component systems, Binary Phase diagrams, Microstructural changes during cooling, The lever rule, Some typical phase diagrams, Other applications of Phase diagrams	4
4	**DIFFUSION IN SOLIDS** Applications of Diffusion, Stability of atoms and ions, Mechanism for Diffusion, Activation energy for Diffusion, Rate of Diffusion (Fick's First Law), Factors affecting Diffusion, Composition Profile (Fick's Second Law), Diffusion and Materials Processing	4
5	**SOLIDIFICATION** Nucleation, Applications of Controlled Nucleation, Growth mechanisms, Solidification time and Dendrite size, Cast structure, Solidification defects, Solidification of Polymers and Inorganic glasses	4
6	**ELASTIC, ANELASTIC AND VISCOELASTIC BEHAVIOUR** Atomic model of elastic behaviour, The modulus as a parameter in design, Rubber-like elasticity, Relaxation processes, Spring-Dashpot model	4
7	**MECHANICAL BEHAVIOUR OF MATERIALS** Plastic deformations and creep in crystalline materials, Fracture	4
8	**ELECTRONIC AND MAGNETIC BEHAVIOUR OF MATERIALS** Conductivity of metals and alloys, Superconductivity, Semiconductors and their applications, Insulators and Dielectrics, Classification of magnetic materials, Magnetization,	4

	Permeability and magnetic field, Applications of magnetic materials	
9	**OVERVIEW OF MATERIALS** Metals, Ceramics, polymers and composites	4

Course Outcomes:	
1	The student will be able to develop structure-processing-properties co-relationsof materials.
2	The student will be able to describe various phenomena based on the concepts of solidification, Diffusion, mechanical behaviour of materials and compare characteristics of different types of materials such as metals, ceramics, polymers and composite

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Materials Science and Engineering-A First course/ V Raghavan/PHI	2013
2	Materials Science and Engineering, an Introduction/William D. Callister/ John Willey and Sons Inc. Singapore.	2007
3	Principles of Materials Science and Engineering/William Fortune Smith/TataMcGraw- Hill	1990
4	The Science and Engineering of Materials, Donald R Askeland&Pradeep P Phule/ Cengage Learning	2006

Course Name	**:**	**SOLID MECHANICS**
Course Code	**:**	**ESC 204**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course the student will be able to understand the basic concepts of behavior of the materials and analysis the basic structural elements like beams, columns, trusses and circular shafts. The student will be able to apply this knowledge for the design of various civil engineering structures.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**PROPERTIES OF MATERIALS** Introduction, uni-axial tension test, idealized stress- strain diagrams, isotropic, linear, elastic, visco-elastic and plastic materials, compression test, impact test, fatigue test, torsion and bending test.	4
2	**SIMPLE STRESSES & STRAINS** Concept of stresses and strains, relationship between elastic constants, extension of uniform bar & tapered bar under its own weight and due to load applied, stresses produced in compound bars due to axial loads, thermal stresses,	4
3	**COMPOUND STRESSES:** General state of stress, resultant stress and strain circle, prinicipal stresses and principal strains, Mohercircle for compound stresses and strais	4
4	**SHEAR FORCE AND BENDING MOMENT IN BEAMS** Shear force, bending moment, Relation between load, SF and BM, SFD , BMD and axial force diagram for determinate beams under various types of loading.	6
5	**BENDING AND SHEAR STRESSES IN BEAMS** Pure bending ,bending stresses, eccentric loading combined bending and direct stresses , Middle Third rule, composite beams, Variation of shear stresses for various cross-sections of a beam.	5

6	**ANALYSIS OF PLANE TRUSSES** Different types of trusses, Analysis of plane trusses by method of joints and method of sections.	5
7	**TORSION** Torsion equation for circular shaft , shafts under action of varying torque, torsion of composite shafts.	4
8	**COLUMNS & STRUTS** Criteria for stability of columns, Buckling of columns, Euler's theory for various end restraints, Rankine's formula, eccentrically loaded struts, struts with initial curvature, struts with lateral loading.	5
9	**DEFLECTION OF BEAMS** Slope and Deflection in beams by double integration method, Macaulay's method, Moment area method under the action of various loading conditions; slope and deflection in built in and propped beams.	5

Course Outcomes: By the end of this course the student will be able to:	
1	Analysis the simple civil engineering structures under different loading conditions.
2	Understand the behaviour of basic structural elements.
3	Apply this knowledge for the design of various civil engineering structures.
4	
5	

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"An introduction to the Mechanics of Solids", Crandall & Dahi, McGrawHill.	1978
2	"Strength of Material", G.H. Ryder, MacMillan.	2002
3	"Mechanics of Solids", E.P. Popov, Pearson Education.	1978
4	"Mechanics of Materials", E.J. Hearn, Elsevier Publications.	2001
5	"Mechanics of Materials", Punmia and Jain, Laxmi Publications (P) Ltd.	2013
6	"Mechanics of Materials", R.C.Hibbeler, Pearson Higher education.	2013
7	"Strength of Materials", S. Ramammurtham and R. Narayanan, Dhanpat Rai Publishing Comp	2014

Course Name	**:**	**INTRODUCTION TO ELECTRONICS**
Course Code	**:**	**ESC 205**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:

At the end of this course, the student should be able to

1. Identify active and passive components and to solve simple electronic circuits.
2. Explain the fundamental concepts of basic semiconductor devices & digital electronics.
3. Describe the basic principle of operational amplifier along with its applications, A/D, D/A conversion and architecture of 8085 microprocessor.
4. Define the communication system and list the various modulation techniques.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ELECTRONICS:** Need and application of electronics in different areas, Basic elements of electronic system (Active and Passive elements, Sources,	3

	Dependent Sources), KVL and KCL	
2	**SEMICONDUCTOR DEVICES:** Concept of active and passive devices, Semiconductor Devices: Structure, principle of operation, characteristics and applications of PN-Junction (Rectifier, Clipper and Clamper), BJT, Current Components in BJT, Input & Output characteristics Common Emitter (CE), Common Base (CB), Common Collector (CC) configurations, BJT as an amplifier, Construction, working principle and characteristics of FET and MOSFET, Concept of feedback amplifier, Barkhuasen criteria, Oscillators, 555 timer as multivibrator, Four layer devices- SCR, DIAC and TRIAC (Construction, operation and characteristics)	15
3	**DIGITAL PRINCIPLES:** Digital waveforms, digital logic, moving and storing digital information, digital operations, digital integrated circuits	3
4	**OPERATIONAL AMPLIFIER AND ITS APPLICATIONS:** Block diagram, characteristics, inverting and non inverting configurations, Opamp as summing amplifier, difference amplifier, integrator, differentiator	5
5	**A/D AND D/A CONVERTERS:** Basic principle and characteristics, Weighted resistor D/A converter, Binary ladder D/A converter, counter ramp type A/D Converter	4
6	**INTRODUCTION TO MICROPROCESSOR:** Pin diagram, Architecture of 8085 Microprocessor, Concept of Microcontroller and its applications	3
7	**COMMUNICATION SYSTEMS**: Introduction to communication system, communication time line, Various frequency bands used for communication, Block diagram of Analog and Digital communication, need of modulation, Analog modulation techniques (Amplitude and frequency), Digital modulation techniques (PCM,PWM,PPM, PAM, ASK,FSK,PSK, QAM), Introduction to advanced communication systems (Optical and wireless).	9

Course Outcomes: By the end of the course the students will be able to	
1	Identify the various electronic devices and predict their behavior in an electronic system.
2	Draw the architecture of Microprocessor.
3	Differentiate between various modulation techniques in a communication system and relate them to practical systems.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Electronics Devices & Circuit Theory, RL Boylestead & L Nashelsky (PHI)	2009
2	Digital principles & applications, Malvino Leach, TMH	2011
3	Microprocessor Architecture programming and Applications with 8085 by R Gaonkar, Penram International Publishing Pvt ltd.	2002
4	Circuits and Networks: Analysis and Synthesis, Sudhakar and ShyamMohan, TMH	2009
5	Electronic Communication Systems by G. Kennedy, Mc Graw Hill, 4th Edition	2008
6	Electronic Communications, 4th Edition, Roddy & Coolen.	2009

Course Name	**:**	**BASIC ELECTRICAL SCIENCES**
Course Code	**:**	**ESC 206**
Credits	**:**	**04**
L T P	**:**	**3- 0-2**

Course Objectives:

At the end of this course, the student should be able to acquire knowledge of analytical techniques to solve electrical circuits, basic electrical machines, and electrical measuring instruments.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**BASIC DEFINITIONS AND NETWORK THEOREMS** Basic definitions of voltage, current, power and energy. Nodes, branches, loops, mesh, Kirchhoff 's laws, nodal & mesh analysis. Circuit theorems: linearity, superposition, Norton, thevenin, max power transfer.	8
2	**AC CIRCUITS** Introduction, Generation of alternating voltage, sinusoidal waveform, phasor diagram, power relations in AC circuits, single phase AC circuits, Steady State Analysis: Nodal and Mesh analysis, Thevenin's, Norton's, Maximum Power Transfer theorems. AC Power Analysis: Instantaneous and average power, max average power transfer, RMS value, apparent power and power factor, complex power, conservation of AC power. THREE PHASE CIRCUITS**:** Phase sequence, Star and delta connection, Relation between line and phase voltages and currents in balanced systems, Analysis of balanced and Unbalanced three phase circuits, Measurement of active and reactive power.	10
3	**MAGNETICALLY COUPLED CIRCUITS** Mutual Inductance, Energy in a coupled circuit. Transformer : construction, equivalent circuit, voltage regulation, efficiency, OC and SC tests.	5
4	**DC MACHINES** Construction, emf and torque equations, circuit model, methods of excitation, characteristics of generators and motors, starting and speed control of dc motors, starters, losses, efficiency.	5
5	**AC MACHINES** Rotating magnetic field theory, three phase induction machines: General construction features, per phase equivalent circuit, approximate equivalent circuit, production of torque, slip, torque speed characteristics, no load and blocked rotor test to determine performance parameters, Starting: rotor rheostat starter, reduced voltage starting, star delta starting, centrifugal start. Synchronous motors: types, salient pole and cylindrical rotor, emf equation. Principle of operation of single phase induction motor, types and applications.	10
6	**BASIC MEASURING INSTRUMENTS** Introduction, Classification of instruments, essential features and operating principles, moving coil and moving iron instruments.	4

List of Experiments:		Number of Turns
1	Verification KCL and KVL	01
2	Verification of Ohm's Law	01
3	Verification of the principle of , superposition with ac and dc sources	01
4	Verification of Thevenin, and Nortan theorems.	01
5	Verification of maximum power transfer theorem in dc circuit.	01
6	To study resonance in series and parallel RLC circuits and plot various responses.	01
7	To verify the line voltage and phase voltage , and line current and phase current relationship in a star and delta three phase balanced circuit.	01
8	Measurement of active and reactive power in single-phase ac circuit.	01
9	To perform open and short circuit test on a 1-phase transformer and determine its equivalent circuit and efficiency	01
10	To study dc machine and determine open circuit characteristic.	02
11	To perform open circuit test and block rotor test on a 3 phase IM to draw equivalent circuit.	01
12	To perform load test on D.C. shunt motor.	01

Course Outcomes: By the end of this course, the student will be able to:	
1	Apply different techniques to solve electrical circuits.
2	Acquire the knowledge of electrical machines and electrical measuring instruments.
3	Design and conduct experiments, as well as analyze and interpret data.

Suggested Books:

Sr. No.	Name of Book/ Authors/ Publisher	Year of Publication/ Reprint
1	Fundamentals of Electric Circuits by Charles K Alexander and Matthew N O Sadiku, Mc Graw Hill Higher Education, 5th edition, ISBN 0073380571.	2012
2	Network Analysis & Synthesis by FF Kuo, Wiley International	1966
3	Electric Machinery and Transformers by Bhag S Guru & Huseyin R Hiziroglu, Oxford University Press, ISBN 0195138902.	1988
4	Semiconductor Physics and Devices: Basic Principles by Donald A Neamen, Irwin Professional Publishing, 3rd Revised edition, ISBN 0256242143	2006

Course Name	**:**	**MECHATRONICS**
Course Code	**:**	**ESC 207**
Credits	**:**	**04**
L T P	**:**	**3-1-0**

Course Objectives:

At the end of this course the student should be able to have basic knowledge of mechatronics and its interdisciplinary applications i.e. integration of Mechanical engineering with Electrical& Electronics Engineering and Computer Technology. He should be able to design and conduct experiments as well as to analyze and interpret data.

Total No. of Lectures – 42

Lecture wise breakup		Number of Lectures
1	**INTRODUCTION TO MECHATRONICS** Understanding Mechatronics. Key Elements of Mechatronics, Components of Mechatronics ,Human Being and Mechatronic System, Conventional and Mechatronic Approach, Advantages of Mechatronic Systems. Definition of System, Classification of System, Mechanistic System, Mechatronic System Intelligence.	04
2	**SENSOR AND TRANSDUCERS: PRINCIPLES AND APPLICATIONS** Role of Sensors and transducers in Mechatronics System , selection of sensors based on performance characteristics, static and dynamic characteristics); calibration; types of sensors , resistive transducers, inductive ,capacitive ,optical , thermal Transducer and their applications ,Measurement of : linear , angular position, displacement, rotational speed, force, pressure, strain, flow rate, temperature etc..	08
3	**SIGNAL CONDITIONING DEVICES** Role of signal conditioning **Processes** and devices in mechatronics, passive elements (RLC), semiconductors devices (PN junction diodes, AC rectification, Zener diode, Power supplies, transistors, Transistor (common emitter characteristics, emitter, follower circuit, FET); thyristor, TRIAC,DIAC, operational amplifiers (inverting, unity gain, non-inverting, C/V and V/C amplifiers, differential amplifier, instrumentation amplifier).Filters types of filters. **SIGNAL CONVERTING DEVICES**: Digital to analog converter (DAC) and Analog to Digital Converter (ADC), multiplexer.	09
4	**DIGITAL ELECTRONICS** Boolean algebra; digital electronic gates; combination logic systems (simple gates, NAND and NOR gates, latches, positive and negative logic, tri-state logic); sequential logic systems (J-K flip-flop, registers and counter, timers and pulse circuits).	05
5	**MICROPROCESSORS , MICROCONTROLLERS AND PLC'S** Fundamentals of microprocessor , the 8085, concept of interfacing memory, input /output devices , fundamentals of Microcontroller, T he 8051, PLC Hardware, PLC Memory structure, application	07

6	**ACTUATORS** Role of actuators in mechatronics, types of actuators, electrical actuators Physical principles; solenoid-type devices; DC machines; AC machines; stepper motors .Drive Technology Applications: Linear motors; voice coil motors; electro-pneumatic and electro-hydraulic actuators. Mechanical actuators :Rotary to linear motion conversion; power transmission, Electromechanical System Applications, Coupling, gearing, belts, pulleys, bearings.	07
7	**CASE STUDIES** Washing Machines, auto focusing camera, pick and place robot.	02

List of Experiments:		**Number of Turns**
1	To study various types of Resistors, Inductors, Capacitors, Diodes, Transistors, LED.	01
2	To study CRO, Function generator, Power Supply.	01
3	To study various components of Induction Machine and Synchronous Machine	01
4	To study various components of DC Machines and Transformers.	01
5	To obtain output voltage waveforms of half wave and full wave uncontrolled rectifier with and without filter capacitor.	02
6	To design a voltage regulator using Zener Diode and analyze the performance of the regulator for various loads. Also compare the performance with a linear voltage regulator.	02
7	To verify truth-tables of various flip-flops (J-K, D, Toggle etc.)	01
8	To study the characteristics of LVDT using linear displacement trainer Kit & compare with ideal characteristics.	01
9	To measure the strain of the metal strip using strain gauge trainer kit & compare with ideal characteristics.	01
10	To measure the angular displacement of resistive & capacitive transducer using angular displacement trainer kit & compare with ideal characteristics.	01
11	To obtain the characteristics of RTD, Thermistor, thermocouple with hot and cold junction thermal trainer kit & compare with ideal characteristics.	01

Course Outcomes: By the end of this course, the student will be able to:	
1	Students were able to have basic knowledge of mechatronics and its interdisciplinary applications i.e. integration of Mechanical engineering with Electronics
2	Students were able to design and conduct experiments

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Mechatronics, fourth edition, by W Bolton. ISBN 978-81-317-3253-3	2013
2	Dan Necsulescu Mechatronics published by Pearson Education (Singapore) Pvt. Ltd., Indian Branch, 482 FIE, Patparganj, Delhi India.	2001
3	Book by H M T Limited, Mechatronics Tata McGraw Hill Publishing Company Limited, New Delhi.	1988
4	Mechatronics Principles, Concepts & Applications by Nitaigour P Mahalik published by TMH	2003

Course Name	**:**	**MECHANICAL ENGINEERING DRAWING**
Course Code	**:**	**ESC**
Credits	**:**	**4**
L T P	**:**	**2-0-4**

Course Objectives:

At the end of this course, the student should be able to visualize objects and their graphical representations, understand the various engineering drawing symbols, conventions and other requirements of assembly and dis-assembly of mechanical engineering parts and materials and should be able to draw clear and understandable production drawings.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO ENGINEERING GRAPHICS:** System of Projections. Technical lettering. Drawing conventions, Orthographic projections. 3-views. Projection of oblique areas. Circular features. Dimensioning, Rules of dimensioning.	3
2	**ISOMETRIC PROJECTIONS:** General introduction to Isometric Projections. Conversion from orthographic to isometric projections and vice-versa. Freehand sketching.	3
3	Projections of Points, Lines and Planes. Geometrical Constructions.	5
4	Projection of Solids, sectioning. Auxiliary planes and views.	3
5	**REQUIREMENTS OF MECHANICAL ENGINEERING DRAWINGS:** Conventional representation, Layout of drawing sheet, symbols of standard tolerances, machining symbols. Introduction and familiarization of the code IS:296.	3
6	**FASTENERS:** Temporary and Permanent fasteners. Various types of screw threads, nuts and bolts, screws, welding joints and riveted joints.	3
7	**INTRODUCTION TO AUTOCAD:** Basic commands and features, simple exercises of points, lines, planes and solids on AutoCAD.	3
8	**ASSEMBLY AND DIS-ASSEMBLY DRAWING EXERCISES ON SOME OF THE FOLLOWING USING DRAWING SHEETS AS WELL AS AUTOCAD:** Couplings, Clutches, Knuckle and cotter joints, Pipe and pipe fittings, IC engine parts, Machine tool parts, Bearings, Screw Jack, Drill press vice.	5

List of Experiments:		**Number of Turns**
1	Drawing exercises on lettering, dimensioning, points, lines and planes	3
2	Drawing exercises on solids, sectioning and auxiliary planes	3
3	Drawing exercises on isometric and orthographic projections	2
4	Introduction to AutoCAD, familiarization with basic commands and features	2
5	Simple exercises of points, lines, planes, solids and sectioning of solids on AutoCAD	2
6	Drawing of machine parts on AutoCAD	2

Course Outcomes: By the end of this course, student will be able to	
1	Have knowledge of drawing symbols, conventions and methods of graphical representations.
2	Understand various machine components, their working and functions.
3	Able to read and understand mechanical engineering drawings.
4	Have working knowledge of the drafting package AutoCAD.
5	Able to understand and draw mechanical engineering drawings on AutoCAD.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Engineering Drawing by R. K. Dhawan	2012
2	Machine Drawing by R. K. Dhawan	2012
3	Engineering Drawing by P. S. Gill	2013
4	Machine Drawing by P. S. Gill	2013
5	Fundamentals of Engineering Drawing by Luzadder and Duff	2009
6	Engineering Graphics with AutoCAD by James D. Bethune	2011

TECHNICAL COMMUNICATION

Course Name	**:**	**TECHNICAL COMMUNICATION**
Course Code	**:**	**XXX-205**
Credits	**:**	**2**
L T P	**:**	**0-0-3**

Course Objectives:
At the end of the course the students should be able to effectively communicate as per their professional requirements.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Need for Effective Communication, Overview of Technical and Professional communication	**3**
2	Listening Skills, Reading Skills, Writing Skills	**3**
3	Writing Letters, Official E-mails, Job Applications, Resumes, Cover Letters, Notes. Case Studies	**6**
4	Overview of Research Writing. Information Gathering; Using the Library and Internet Modes, Organizing and Presenting According to Audience and Purpose. Writing Research Proposals, Project Technical Report/ Dissertation/Theses Writing. Case Studies.	**12**
5	Presentation Skills, Interview Skills, Group Discussion skills, Case Studies.	**9**
6	Technology Based Communication- Use of Visuals and Audio to Communicate Effectively.	**3**
7	Ethics, Attitude and Team Communication	**3**
8	Social Media/ Online Communication, Public Speaking; Developing an Authorial Voice	**3**

Course Outcomes: By the end of this course the student will be able to	
1	Develop effective technical communication.
2	Write technical documents in a professional manner.
3	Present professional requirements in an effective manner

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Meenakshi Raman and Sangeeta Sharma, "Fundamentals of Technical Communication", Oxford University Press, India	2014
2	Barun K Mitra, "Effective Technical Communication- A Guide for Scientists and Engineers" ,Oxford University Press, India	2006
3	David f Beer and David McMurrey, " Guide to Writing as an Engineer" ,2nd ed., Wiley	2004
4	Diane Hacker, " Pocket Style Manual", Bedford/St martin's.	2003

Course Name	**:**	**OPERATIONS RESEARCH**
Course Code	**:**	**MAN 401**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course , the students should be able to describe the need of Operations Research, develop the ability to form Mathematical models of Optimization problems, identify and solve linear models of Optimization problems, apply and to describe the limitations of classical methods to solve non-linear models of Optimization problems, apply and to describe the limitations of The Transportation Model ,Decision theory, Queuing Model.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scientific method in Operations Research, Necessity of Operations Research in industry, Scope of Operations Research	6
2	Formulation of Linear Programming problem , Graphical Solution, Simplex Method, Unrestricted variables, Artificial variables, M-Method, Dual Phase method	12
3	Introduction to the Transportation model, Assumption in the Transportation Model, Definition of the Transportation Model, Matrix terminology, Formulation and solution of Transportation Model	6
4	Decision theory, Steps in Decision theory approach, Decision making environments, Decision making under conditions of certainty, Decision making under conditions of uncertainty, Decision making under conditions of risk, Maximum likelihood criterion	6
5	Queuing Model, Introduction, Application of Queuing Model, Elements of Queuing System, Operating characteristics of Queuing System, Waiting time and idle time costs.	6
6	Non – Linear Programming, Introduction , Local and Global optimum, Concave and Convex functions, Types of non-linear programming problems.	6

Course Outcomes: By the end of this course, the students will be able to :	
1	Form Mathematical model of Optimization problems
2	Distinguish between linear and non-linear models
3	Solve simple problems of The Transportation Model
4	Solve simple problems of Decision theory
5	Solve simple problems of Queuing Model

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Operations Research" , Ravindran , Phillips , and Solberg , 2nd edition, John Wiley & sons .	2000
2	"Engineering Optimization" , S S Rao , 3nd edition, New Age .	2000
3	"Operations Research", Kantiswarup, Gupta P.K. & Sultan Chand & Sons .	2007
4	"Operations Research", Sharma S.D., Kedarnath, Ramnath & Company .	1994
5	"Operations Research", Bronson R, Shaum's Outline Series .	1997

Course Name	**:**	**OPTIMIZATION TECHNIQUES**
Course Code	**:**	**MAN 402**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the student shoule be able to describe the need of Optimization Techniques , develop the ability to form mathematical model of optimization problems , identify and solve linear models of optimization problems , apply and to describe the limitations of classical methods to solve nonlinear models for optimization problems , apply and to describe the limitations of gradient based and direct iterative methods to solve nonlinear problems.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**LINEAR PROGRAMMING** Formulation, Graphical solution, Simplex method , Relation between Graphical and Simplex method, Unrestricted variables, Artificial variables, M-Method and Dual Phase method	**(14)**
2	**OPTIMIZATION TECHNIQUES** **UNCONSTRAINED PROBLEMS -** (Single and multivariable optimization) Necessary and sufficient conditions for extreme points **CONSTRAINED PROBLEMS - (**multivariable optimization) Equality constraints , Jacobian and Lagrangean methods , Application of Jacobian method to linear problems	**(12)**
3	**NON-LINEAR PROGRAMMING PROBLEMS** Geometric Programming **UNCONSTRAINED ALGORITHMS –** Direct methods, Dichotomous and Golden search ; Univariate and Hooke and Jeeves search methods ; Gradient methods , Cauchy's steepest ascent method and Newton's method.	**(12)**
4	**PROGRAMMING TECHNIQUES** Separable programming ,Geometric Programming	**(4)**

Course Outcomes:	
1	Form mathematical model of optimization problems
2	Distinguish between linear and nonlinear models .
3	Solve simple problems using classical / iterative methods .

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	Operations Research , Ravindran , Phillips , and Solberg, 2nd edition 2000 , John Wiley & sons .	2000
2	Operations Research by Hamady Taha, 8th edition	
3	Engineering Optimization , S S Rao , 3rd edition 2000 , New Age .	2000
4	Operations Research 9th Edition, Kantiswarup, Gupta P.K. & Sultan Chand & Sons .	
5	Operations Research 8th Edition, Sharma S.D., Kedarnath, Ramnath & Company .	
6	Operations Research 2nd Edition, Bronson R, Shaum's Outline Series .	
7	P. Sankara Iyer, "Operations Research", Tata McGraw-Hill, 2008.	2008
8	J K Sharma., "Operations Research Theory & Applications , 3e", Macmillan India Ltd, 2007	2007
9	P. K. Gupta and D. S. Hira, "Operations Research", S. Chand & co., 2007.	2007

Course Name	**:**	**ADVANCED PHYSICS**
Course Code	**:**	**PYN-401**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems in Nuclear and Solid State physics.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Quantum theory of light, X-rays - production, spectrum & diffraction(Bragg's Law), photoelectric effect, compton effect, pair production, photons & gravity, black holes, de-Broglie hypothesis, particle diffraction, uncertainty principle and applications. Postulates of quantum mechanics, Schrodinger theory, time-dependent and time-independent Schrodinger equation, wave function, Born interpretation and normalization, expectation values.	10
2	Particle in a box (infinite well potential), finite potential step and barrier problems, tunneling, linear harmonic oscillator (one-dimensional). Hydrogen atom, radiative transitions and selection rules, electron spin, Stern-Gerlach experiment, Spin-orbit coupling, exclusion principle, symmetric and anti-symmetric wave functions. Alpha decay, Zeeman Effect, Correspondence Principle, Angular Momentum in Quantum Mechanics.	10
3	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions. Artificial radioactivity and its application, Beta-decay (energy spectrum & discovery of neutrino), fusion reactions in stars.	10
4	Band theory of solids, Kronig-Penney Model (qualitative), conductors, insulators and semiconductors, p-type and n-type semiconductors, statistics of electrons and holes, Hall effect (for single as well as both type of charge carriers).	6
5	Occurrence of superconductivity, destruction of superconductivity, Meissner effect, type I and type II superconductors, heat capacity, isotope effect, thermodynamical considerations, London equations & penetration depth, coherence length, BCS theory (elementary description), applications of superconductors. High temperature superconductivity, Josephson junctions.	6

Course Outcomes: By the end of this course:	
1	Students will be able to solve numerical problems in Quantum Mechanics, Nuclear and Solid State Physics.
2	Students will be aware of latest developments in certain areas of Physics like condensed matter physics, superconductivity etc. which have important applications for societal needs.
3	Students will be able to correlate the various phenomena with quantum mechanical concepts.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Concepts of Modern Physics", Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013
2	"Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013

3	"Introductary Nuclear Physics", Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014
4	"Modern Physics", J. Bernstein, P.M. Fishbane and S.G. Gasiorowicz, Pearson, Education India Pvt. Ltd., New Delhi	2009

Course Name	**:**	**CRYSTAL PHYSICS**
Course Code	**:**	**PYN-402**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
During this course students will understand basics of crystal structure and correlate the same with different material properties. They will be able to describe the concepts of lattice dynamics and crystal binding forces and correlate the same with thermal properties.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**CRYSTAL STRUCTURES** - Periodic array of atoms, Lattice, basis, primitive cell, two and three dimensional lattice types, miller indices, examples of crystal structures (NaCl, CsCl structures), Hexagonal closed packed, diamond, zinc sulfide structures, x-ray diffraction of crystal, Bragg's Law, reciprocal lattice, diffraction condition, Laue equation, structure factor, atomic form factor.	12
2	**CRYSTAL BINDING** - van der waals interaction, repulsive interaction, equilibrium lattice constant, cohesive energy, ionic crystals, covalent crystals, electrostatic energy, Madelung constant.	10
3	**PHONONS AND CRYSTAL VIBRATIONS** - monoatomic basis, first Brillouin zone, dispersion relation, two atoms per primitive basis, quantization of elastic waves, phonon momentum, inelastic scattering by phonon.	10
4	**THERMAL PROPERTIES** - phonon heat capacity, density of states, Einstein model, Debye model of heat capacity, inharmonic crystal interaction, thermal expansion. Thermal conductivity, Umklapp Processes.	10

Course Outcomes: By the end of the course	
1	Students will be able to solve the problems based on crystal structure and thermal properties of solids
2	Understand and apply the basic concepts of crystal binding and crystal vibrations in different phenomena.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Introduction to Solid State Physics", Charles Kittel, Wiley India Pvt. Ltd., New Delhi	2012
2	"Solid State Physics", S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	"Crystallography Applied to Solid State Physics", Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	**:**	**SOLID STATE PHYSICS**
Course Code	**:**	**PYN-403**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
During this course students will understand basics of free electron theory. They will study the origin of energy gaps on the basis of quantum mechanics approach. They will cover advance topics in dielectrics. Superconductivity will also be covered and student's interest will be created in possibility of high temperature superconductivity.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Free electron theory, energy levels in one dimension, free electron gas in three dimension, heat capacity of electron gas, electrical conductivity and ohm's law, experimental electrical resistivity of metals, Hall Effect.	12
2	Energy bands, origin of energy gap, bloch functions, Kronig-Penny model, brillouin zones, metals and insulators.	10
3	Dielectric function of the electron gas, plasma optics, dispersion relation of electromagnetic wave, transverse optical modes in plasma, longitudinal plasma oscillations, polaritons, electron-phonon interaction polarons, optical processes and excitons.	12
4	Occurrence of superconductivity, destruction of superconductivity, Meissner effect, type I and type II superconductors, heat capacity, isotope effect, thermodynamical considerations, London equations & penetration depth, coherence length, BCS theory (elementary description), applications of superconductors. High temperature superconductivity, Josephson junctions.	8

Course Outcomes: By the end of the course, student will be able to	
1	Solve the problems based on free electron theory and band theory of solids.
2	Understand and apply the basic concepts of plasma optics and superconductivity in different phenomena.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Introduction to Solid State Physics", Charles Kittel, Wiley India Pvt. Ltd., New Delhi	2012
2	"Solid State Physics", S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	"Crystallography Applied to Solid State Physics", Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	**:**	**MODERN INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS**
Course Code	**:**	**CHN 401**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, the student should be able to introduce the principles of chemical analysis, matrix effects, detailed instrumentation, operation and interpretation of data, error analysis and statistical methods of data handling.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**SPECTROSCOPIC TECHNIQUES:** UV – Visible, Infra red, NMR, and Mass Spectroscopy-Principles Instrumentation and Applications	10
2	**ATOMIC ABSORPTION SPECTROMETRY AND EMISSION SPECTROMETRY:** Inductively coupled plasma atomic emission spectroscopy (ICP-AES) - Principles	8

	Instrumentation and Applications	
3	**OPTICAL MICROSCOPY**: Scanning Electron Microscopy (SEM),Transmission Electron Microscopy (TEM) and Scanning Transmission Electron Microcopy (STEM) -Principles and Applications	6
4	**X-RAY TECHNIQUES**: XRD, XRF, XPS-Principles and Applications	8
5	**THERMAL ANALYSIS**: DTA, TGA- Principles Instrumentation and Applications	5
6	**CHROMATOGRAPHIC ANALYSIS**: GC, HPLC- Principles Instrumentation and Applications	5

Course Outcomes: By the end of this course, the student will be able to:	
1	Handle the analysis of mg, ppm and ppb levels of analyte by appropriate instrumental methods.
2	Carry out Chemical analysis of hazardous materials, environmental samples, inorganic, organic and biomaterials at trace and ultra trace quantities.
3	Differentiate among molecular absorption, atomic absorption and atomic emission spectrometry.
4	Carry out hands on experiments in the field related to analysis of materials required for technological developments and in advanced research in Engineering.
5	Differentiate between classical and instrumental methods of Chemical analysis.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Interpretation of Mass Spectra", McLafferty F.W., 3rd Edition, Pubs: W.A. Benzamine, New York.	1993
2	"Spectrometric Identification of Organic Compounds", Silverstein R.M. and Bassler G.S., 5th Edition, Pubs: John Wiley.	1991
3	"Instrumental Analysis", Willard H.H., Merritt L.L. and Dean J.A., 7th Edition, Pubs: Van Nostran Reinhold.	1998
4	"Instrumental Analysis", Skooq D.A. Holler F. J. and Crouch S. R., Pubs: Brooks/Cole.	2007
5	"Analytical Chemistry", Christian G.D., 5th Edition, Pubs: John Wiley.	1994
6	"X-ray structure determination a practical guide", Stout G.H. and Jeansen L.H., Pubs: John Wiley & Sons, New York.	1989
7	"Crystal structure analysis for chemists and biologists", Glusker J.P., Lewis M, Pubs: VCH Publisher inc., New York.	1994
8	"Structure Determination by X-ray crystallography", Ladd, M.F.C. and Palmer R.A., Pubs: Plenum Press, New York.	1994

Course Name	**:**	**PRINCIPLES OF MANAGEMENT**
Course Code	**:**	**HSM 401**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:

The main aim of this course is to make students understand the management process and principles along with its application in practical life and to help them manage different jobs and situations with the help of management functions.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO MANAGEMENT** Nature of Management: Art or Science, Principles and Functions of Management	**3**
2	**EVOLUTION OF MANAGEMENT THOUGHT** Classical Theories: Bureaucratic, Scientific and Administrative Approach	**6**

	Neo-Classical Theories: Human Relations and Human Behaviour Approach Modern Theories of Management Relevance of Management Thought in present scenario – Management Cases	
3	**PLANNING** Nature of Planning, Planning Process, Application of Planning Process in a Hypothetical Situation, Types of Planning, Types of Plans, Management by Objective (MBO)	**4**
4	**ORGANIZING** Concept of Organization, Departmentation, Forms of Organization Structure Analysis of Organization Structure – Case Studies Hypothetical Formation of an Organization	**4**
5	**STAFFING** Human Resource Planning: HRP Process, Job Analysis: Job Description, Job Specifications and Used of Job Analysis Recruitment: Sources and Methods Selection: Selection Process, Role Playing and Case Study on Selection Tests and Interviews Training and Development: Techniques, Performance Appraisal: Methods Case Study on Staffing Practices	**6**
6	**DIRECTING** Concept, Leadership: Importance and Styles, Motivation: Theories and their relevance in present scenario, Communication: Process, Types and Barriers of Communication Management Game on Leadership, Motivation and Communication	**3**
7	**CONTROLLING** Nature and Process of Controlling, Requirements for Effective Controlling	**2**

Course Outcomes:	
1	The students will be able to apply management concepts and principles in daily life and thus, will be able to manage things efficiently and effectively.
2	The students will learn how to get work done easily by using management knowledge and functions.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Principles and Practices of Management", Rao V.S.P. and Narayana P.S., Pubs: Konark Publishers.	1987
2	"Principles & Practice of Management", Prasad L.M., 8th Edition, Pubs: Sultan Chand & Sons.	2012
3	"Essentials of Management: International and Leadership Perspective", Weihrich H. and Koontz H., 9th Edition, Pubs: McGraw Hill.	2012
4	"The New Era of Management", Daft R.L., 11th Edition, Pubs: Cengage Learning.	2014
5	"Management: Text and Cases", Rao V.S.P. and Krishna V.H., Pubs: Excel Books.	2008
6	"Fundamentals of Management: Essential Concepts and Applications", Robbins S.P, DeCenzo D.A., Bhattacharya S. and Agarwal M.N., 6th Edition, Pubs: Pearson India.	2009

Course Name	**:**	**BUSINESS ENVIRONMENT AND BUSINESS LAWS**
Course Code	**:**	**HSM 402**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:

The main aim of this course is to make students understand different types of environment influencing business decisions and to provide knowledge about different laws that needs to be followed for initiating and managing business.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO BUSINESS** Scope and Characteristics of Business, Classification of Business Activities Forms of Ownership of Business: Sole Proprietorship, Partnership and Company	**5**
2	**BUSINESS ENVIRONMENT** Internal Environment: Concept and Elements (Value System, Vision Mission Objectives, Management Structure, Human Resources, Company Image etc.) SWOT Analysis: Concept and Case Study External Environment: Micro Environment (Suppliers, Customers, Competitors, Market Intermediaries etc.) and Macro Environment – PESTEL Analysis (Political, Economic, Social, Technological, Ecological and Legal), Case Study on Impact of Environment on Business	**7**
3	**GLOBALIZATION** Concept, Pros and Cons of Globalization, Impact of Global Environment on Business Globalization of Company – Case Study	**4**
4	**CORPORATE SOCIAL RESPONSIBILITY** Concept, Social Responsibility towards different stakeholders, Rationale for CSR CSR – Case Studies	**2**
5	**CORPORATE GOVERNANCE** Concept, Elements and Essentials of Good Governance	**3**
6	**CONTRACT LAW** Concept, Types and Essentials Elements of Contract	**3**
7	**PARTNERSHIP LAW** Nature of Partnership, Provisions of Partnership Act, Issues Related to Partnership Firm, Hypothetical Formation of a Partnership Firm	**2**
8	**COMPANY LAW** Nature of Company, Provisions of Company Act, Issues Related to Incorporation of Company, Hypothetical Formation of a Company	**2**

Course Outcomes:	
1	The students will be able to analyze the impact of environment on business and formulate appropriate business strategies to compete in the competitive world.
2	The students will learn how companies follow corporate governance and social responsibility practices along with fulfilling economic objectives.
3	The students will gain knowledge about application and implementation of various business laws in practice.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Business Environment: Text and Cases", Cherunilam F., 22nd Edition, Pubs: Himalaya Publications.	2013
2	"Legal Aspects of Business", Pathak A., 5th Edition, Pubs: McGraw Hill Education.	2013
3	"Essential of Business Environment: Text, Cases and Exercises", Aswathappa K., 11th Edition, Pubs: Himalaya Publication.	2011
4	"Business Law Including Company Law", Gulshan S.S. and Kapoor G.K., 15th Edition, Pubs: New Age International (p) Ltd.	2011

5	"Business Law and Corporate Laws", Tulsian P.C., 1st Edition, Pubs: Sultan Chand Publishing.	2011
6	"Fundamentals of Business Organization & Management", Bhushan Y.K., 19th Edition, Pubs: Sultan Chand & Sons.	2013
7	"Corporate Governance: Principles, Policies and Practices", Fernando A.C., 2nd Edition, Pubs: Pearson India.	2011

Course Name	**:**	**FINANCIAL MANAGEMENT**
Course Code	**:**	**HSM 404**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:
The main aim of this course is to make students learn different financial decisions i.e. investing, financing and dividend, required to be taken by a company and provide knowledge about the functioning of the financial system (financial markets, financial institutions, financial services and financial instruments) of the country.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO FINANCIAL MANAGEMENT** Concept of Finance, Terminology Related to Finance, Financial Decisions, Factors Affecting Financial Decisions, Risk-Return Trade-Off	**3**
2	**FINANCIAL SYSTEM** Concept and Role of Financial System in Indian Economy	**2**
3	**FINANCIAL MARKETS AND INSTRUMENTS** Concept and Relevance of Money Market and Capital Market Money Market Instruments: Call Money, Treasury Bills, Commercial Papers, Certificate of Deposits Capital Market Instruments: Equity Shares, Preference Shares and Debentures Hypothetical Trading in Financial Markets	**5**
4	**FINANCIAL SERVICES** Nature and Functions of Financial Services: Merchant Banking, Mutual Funds, Factoring, Forfaiting, Credit Rating Case Study on Financial Services	**6**
5	**FINANCIAL INSTITUTIONS** Nature and Functions of Financial Institutions: Reserve Bank of India (RBI), Securities and Exchange Board of India (SEBI), Discount and Finance House of India (DFHI)	**2**
6	**LONG TERM INVESTMENT DECISIONS** Capital Budgeting: Concept, Importance, Factors Techniques/Methods with Numerical Applications (Pay Back Period, Accounting Rate of Return, Net Present Value, Internal Rate of Return and Profitability Index), Case Study	**3**
7	**SHORT TERM INVESTMENT DECISIONS** Working Capital: Nature, Type and Factors Affecting the Requirement of Working Capital, Case Study	**2**
8	**FINANCING DECISIONS** Capital Structure: Essentials and Approaches of Capital Structure Sources of Finance (long-term and short-term), Financial Leverage: Concept and Numerical Application, Case Study	**3**
9	**DIVIDEND DECISIONS** Types of Dividend, Dividend Policy: Nature and Factors Affecting Dividend Policy, Case Study	**2**

Course Outcomes:	
1	The students will learn to make best combination of financial decisions by considering risk and return trade-off.
2	The students will identify how business can gain maximum through the financial system.
3	The students will understand how to manage funds effectively so as to maximize returns.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Financial Management", Shah P., 2nd Edition, Pubs: Dreamtech Press	2009
2	"Financial Markets and Services", Gordon E. and Natarajan K., 3rd Edition, Pubs: Himalaya Publishing House.	2006
3	"Financial Management: Theory and Practice", Chandra P., 8th Edition, Pubs: McGraw Hill Education (India).	2012
4	"Financial Management", Pandey I.M., 10th Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2010
5	"Cases in Financial Management", Pandey I.M. and Bhat R., 3rd Edition, Pubs: McGraw Hill Education (India).	2012
6	"Financial Institutions and Markets: Structure, Growth and Innovations", Bhole L.M. and Mahakud J., 5th Edition, Pubs: McGraw Hill Education (India).	2009
7	"The Indian Financial System: Markets, Institutions and Services", Pathak B.V., 3rd Edition, Pubs: Pearson India.	2010
8	"Financial Management and Policy", Horne J.C.V. and Dhamija S., 12th Edition, Pubs: Pearson India.	2011

Course Name	**:**	**MARKETING MANAGEMENT**
Course Code	**:**	**HSM 405**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:
The main aim of this course is to make students understand about the marketing concepts to be applied in real life and the marketing process for delivering value to customers.

Total No. of Lectures –28

Lecture wise breakup		Number of Lectures
1	**INTRODUCTION TO MARKETING** Concepts, Role, Scope and Types of Marketing, Case Study on Marketing Management	**3**
2	**MARKETING RESEARCH** Scope and Process of Marketing Research, Hypothetical Marketing Research Analysis	**3**
3	**CONSUMER AND BUSINESS MARKETS** Types of Markets, Building Customer Value Consumer and Business Buying Behaviour: Factors Influencing Behaviour and Buying Decision Process	**4**
4	**SELECTION OF MARKETS** Segmentation: Factors and Bases, Targeting and Positioning Preparation of STP of Selected Product	**3**
5	**MARKETING MIX** 7 P's of Marketing Mix: Product, Price, Physical Distribution, Promotion, People, Process	**3**

	and Physical Evidence Formulation of Marketing Mix of Selected Product	
6	**PRODUCT DECISIONS** Product (Good or Service) Characteristics, Product Life-Cycle, Packaging and Branding, Product Development and Management	**3**
7	**PRICING DECISIONS** Pricing Policies and Strategies, Factors Influencing Pricing	**3**
8	**PHYSICAL DISTRIBUTION DECISIONS** Marketing Channels, Channel Players, Physical Distribution, Managing Distribution, Analysis of Supply Chain Management – Case Studies	**3**
9	**PROMOTION DECISIONS** Nature of Promotion Decisions, Managing Mass Communication and Personal Communication Analysis of Promotional Strategies – Case Studies	**3**

Course Outcomes:	
1	The students will learn how to market goods and services effectively to different segments so as to deliver value to customers.
2	The students will be able to formulate marketing mix and marketing strategies for different products and different sets of customers.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Marketing Management: Concepts, Cases, Challenges and Trends", Govindarajan M, 2nd Edition, Pubs: PHI Learning.	2009
2	"Marketing Management", Kotler P., Keller K.L., Koshy A. and Jha M., 14th Edition, Pubs: Pearson India.	2012
3	"Marketing Concepts and Strategies", Dibb S., Simkin L., Pride W.M. and Ferrell O.C., Pubs: Cengage Learning.	2012
4	"Marketing Management", Kumar A. and Meenakshi N., 2nd Edition, Pubs: Vikas Publishing House Pvt. Ltd., Noida.	2011
5	"Marketing Management", Saxena R., 4th Edition, Pubs: McGraw Hill Education (India).	2013
6	"Marketing: Managerial Introduction", Gandhi J.C., 1st Edition, Pubs: McGraw Hill Education.	1987
7	"Marketing", Etzel M.J., Walker B.J., Stanton W.J. and Pandit A., 14th Edition, Pubs: McGraw Hill Education (India).	2010
8	"Super Marketwala: Secrets to Winning Consumer India", Mall D., 1st Edition, Pubs: Random House India.	2014

Course Name	**:**	**HUMAN RESOURCE MANAGEMENT**
Course Code	**:**	**HSM 406**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:
The main aim of this course is to provide an overview of HRM, keeping the Indian business scenario in the background and to acquaint the students with the strategic role of HRM in managing an organization.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO HUMAN RESOURCE MANAGEMENT** HRM: Nature, Scope, Functions, HRM Practices and Problems in India with Case Studies	**4**

2	**HUMAN RESOURCE PLANNING (HRP)** Concept and Process of HRP, Factors Affecting HRP	**3**
3	**JOB ANALYSIS AND DESIGNING** Uses and Process of Job Analysis, Job Description and Job Specification: Features and Hypothetical Formulation, Job Designing: Job Enrichment, Job Enlargement	**3**
4	**RECRUITMENT AND SELECTION** Recruitment: Sources and Methods Selection: Selection Process, Selection Tests, Types and Nature of Interviews Role Playing and Case Study on Selection Process, Tests and Interview	**4**
5	**INDUCTION AND INTERNAL MOBILITY** Induction Programme, Need and Scope of Internal Mobility: Transfer, Promotion, Demotion	**3**
6	**TRAINING AND DEVELOPMENT** Training: Need and Methods, Management Development: Need, Methods and Management Development Programme HRM Games for Development of Employees	**4**
7	**PERFORMANCE APPRAISAL AND COMPENSATION** Nature and Methods of Performance Appraisal, Hypothetical Performance Appraisal Compensation: Financial and Non-Financial Benefits	**4**
8	**EMPLOYEE HEALTH AND SAFETY** Concept, Issues related to Health and Safety, Workplace Health Hazards	**3**

Course Outcomes:	
1	The students will develop the ability to solve problems in area of HRM in organizations.
2	The students will become aware of latest developments in HRM practices which are essential for effective management in organization.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Human Resource Management: Text and Cases", Rao V.S.P., Pubs: Excel Books.	2002
2	"Human Resource Management", Dessler G. and Varkkey B., 12th Edition, Pubs: Pearson India.	2011
3	"Human Resource Management: Text and Cases", Aswathappa K., 7th Edition, Pubs: McGraw Hill Education (India).	2013
4	"Human Resource Management: Text and Cases", Gupta C.B., 14th Edition, Pubs: Sultan Chand and Sons.	2012
5	"Human Resource Management: Text and Cases", Bedi S.P.S. and Ghai R.K., Pubs: Bharti Publications.	2012
6	"Human Resource Management Applications: Cases, Exercises, Incidents and Skill Builders", Fottler M.D., McAfee R.B. and Nkomo S.M., 7th Edition, Pubs: Cengage Learning.	2013

Course Name	**:**	**MANAGING INNOVATION AND CHANGE**
Course Code	**:**	**HSM 431**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:
The main aim of this course is to make students learn how to manage innovation and change in organizations and understand how innovation and change can contribute to business success.

Total No. of Lectures – 28

Lecture wise breakup		Number of Lectures
1	**INTRODUCTION TO INNOVATION AND CHANGE** Concept, Types, Sources, Components, Invention vs. Innovation	4
2	**INNOVATION IN ORGANIZATION** Innovation in Managerial Functions (Planning, Organizing, Staffing, Directing and Controlling), Innovation in Operational Functions (Marketing, Human Resource and Finance) Case Studies and Brainstorming Sessions	3
3	**INNOVATION POLICY** Innovation Cluster, National Innovation Systems	3
4	**INNOVATION MANAGEMENT** Innovation Management: Innovation Strategies, Models, Processes and Structures Case Study on Innovation Management	4
5	**REACTIONS TO CHANGE** Process of Planned Change, Responses to Change, Reasons for Resistance to Change, Change Agents, Stages in Reaction to Change	5
6	**CHANGE MANAGEMENT** Key Dimensions and Factors, Organizational Change, Approaches to Change Management Case Study on Change Management	4
7	**INTELLECTUAL PROPERTY RIGHT (IPR)** Patents, Copyrights and Trademarks	3
8	**DISCUSSIONS ON ADDITIONAL READING** (any one of the following in the semester) - 8 Steps to Innovation – Going from Jugaad to Excellence - Innovation Secrets of Indian CEOs - Jugaad Innovation: A Frugal and Flexible Approach to Innovation for the 21st Century - The Ten Faces of Innovation	2

Course Outcomes:	
1	The student will learn the technological, human, economic, organizational, social and other dimensions of innovation.
2	The students will understand how to encourage, manage and implement innovation and change in organization and how to take a new idea to the stage where it can be implemented.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Managing Change and Transition", Harvard Business School, Pubs: Harvard University Press.	2003
2	"Managing Creativity and Innovation", Harvard Business School, Pubs: Harvard University Press.	2003
3	"Managing Change, Creativity and Innovation", Dawson P. and Andriopoulos C., Pubs: Sage Publications.	2014
4	"Managing Strategic Innovation and Change", Tushman M.L. and Anderson P., 2nd Edition, Pubs: Oxford University Press.	2004
5	"The International Handbook of Innovation", Larisa V.S., Pubs: Elsevier Science.	2003
6	"Managing Innovation and Change", Mayle D., 3rd Edition, Pubs: Sage Publications.	2006
7	"Managing Technology and Innovation for Competitive Advantage", Narayanan V.K., Pubs: Pearson India.	2002
8	"Managing Technological Innovation, Competitive Advantage from Change", Betz F., Pubs: Wiley.	2011

Course Name	**:**	**BUSINESS RESEARCH**
Course Code	**:**	**HSM 432**
Credits	**:**	**4**
L T P	**:**	**2-2-0**

Course Objectives:
The main aim of this course is to make students understand the concepts of business research and learn the methods to formulate, analyze and interpret the business problems.

Total No. of Lectures – 28

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO BUSINESS RESEARCH** Concept and Types of Business Research	3
2	**PROBLEM IDENTIFICATION** Defining Problem, Literature Review: Essentials of Literature Review and Writing of Review, Research Objectives: Essentials of Research Objectives and its Formulation	3
3	**FRAMEWORK FOR BUSINESS RESEARCH** Research Questions, Hypothesis: Essentials of Hypothesis and its Formulation, Types of Variables	2
4	**INTRODUCTION TO RESEARCH DESIGN** Purpose and Scope of Research Design, Research Proposal: Elements and Framing a Research Proposal	2
5	**MEASUREMENT SCALES** Rating Scales, Ranking Scales, Reliability, Validity, Questionnaire: Essentials of Questionnaire, Developing a Questionnaire on a Hypothetical Research Problem	4
6	**SAMPLING DESIGN** Concept, Process and Techniques of Sampling, Framing of Sampling Design	3
7	**DATA COLLECTION** Sources and Methods of Data Collection	3
8	**PRESENTATION AND ANALYSIS OF DATA** Tabular, Graphic and Diagrammatic Presentation of Data, Statistical Data Analysis, Presentations and Analysis of Data using MS Excel	5
9	**RESEARCH REPORT** Contents and Characteristics of Project Report, Formulation of Project Report	3

Course Outcomes:	
1	The students will develop ability to tackle problems in business by following research techniques.
2	The students will learn to collect the right data and to analyze and present the data in the right way.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Research Methods for Business: A Skill Building Approach", Sekaran U. and Bougie R., 5th Edition, Pubs: Wiley India Pvt. Ltd., New Delhi.	2011
2	"Research Methodology: Methods and Techniques", Kothari C.R. and Garg G., 3rd Edition, Pubs: New Age International.	2014
3	"Business Research Methods", Bryman A. and Bell E., 2nd Edition, Pubs: Oxford University Press.	2010
4	"Business Statistics", Beri G.C., 3rd Edition, Pubs: McGraw Hill Education (India).	2009
5	"Statistics for Management", Levin R.I., Rubin D.S., Rastogi S. and Siddiqui M.H., 7th Edition, Pubs: Pearson India.	2012

6	"Business Research Methods and Statistics using SPSS", Burns R.P. and Burns R., 1st Edition, Pubs: Sage Publications.	2008
7	"Statistics for Management", Srivastava T.N. and Rego S., 2nd Edition, Pubs: McGraw Hill Education (India).	2012

Course Name	**:**	**ALGEBRA - I**
Course Code	**:**	**MAN 431**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to describe the basic results of Group Theory. They should be able to recognise examples of groups. They should know the definitions of basic terms and should be able to write elements of the symmetric group as cycles or products of transpositions, should know simple uses of Lagrange's Theorem, quotients and products of groups. They should know difference between finding a proof from the axioms that works for all groups, and finding a counter example.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Definition of a group, examples, some preliminary lemmas, Subgroups, examples, Cosets, Order of a group, Lagrange's Theorem,Euler's Theorem, A counting principle.	10
2	Normal subgroups and quotient groups, Homomorphism, Cauchy's Theorem, Sylows Theorem, Automorphism, Cayley's Theorem, Permutation groups, Conjugacy classes, Sylow subgroups and Sylow's Theorem,	16
3	Direct products, Finite abelian groups.	6
4	Vector Spaces: Elementary basic concepts, Linear independence and bases, Dual Spaces.	10

Course Outcomes:	
1	By the end of the course, the students will be able to describe the basic results of Group Theory, recognise examples of groups, know the definitions of basic terms, such as: order of a group, order of an element, subgroup, cyclic group and isomorphism. They will also be able to prove simple consequences, write elements of the symmetric group as cycles or products of transpositions, describe quotients and products of groups.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Topics in Algebra", Herstein, I.N., Wiley Eastern Limited, New Delhi.	1981
2	"Modern Algebra", Singh, S and Zameeruddin, Q ,Vikas Publishing House, New Delhi	2015
3	"Rings and Modules", Musili, C, Narosa Publishing House, (Second Revised Edition),New Delhi.	1994.
4	"Algebra", Artin, M. Prentice Hall of India, New Delhi.	1994
5	"The Theory of Groups of Finite Order", Burnside, W. (2nd Ed.), Dover, New York.	1955

Course Name	**:**	**NUMBER THEORY**
Course Code	**:**	**MAN 432**

Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to describe the fundamental properties of integers and to prove basic theorems. They should be able to solve congruences and Diophantine equations. They should also be able to approximate reals by rationals.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Introduction, Divisibility, Greatest common divisor, The Euclidean algorithm, primes, Fundamental theorem of Arithmetic,	8
2	Congruences, Residue classes and reduced residue classes, Fermat's theorem, Euler's theorem, Wilson Theorem, Solution of congruences , congruences of degree1, Chinese Remainder theorem with applications. Euler's φ-function,	12
3	Congruences of higher degree, prime power modulii, prime modulus, **Primitive roots, Indices and their applications, power residues, Quadratic residues, Quadratic reciprocity, Legendre Symbol, Euler's criterion, Gauss's Lemma, Quadratic reciprocity law, Jacobi symbol,**	10
4	Greatest integer function, arithmetic function, Mobius inversion formula, Diophantine equations **Farey sequences,Continued fractions, approximations of reals by rationals.**	12

Course Outcomes: By the end of the course, the students will be able to	
1	Describe the fundamental properties of integers.
2	Prove basic theorems.
3	Solve congruences.
4	Sove Diophantine equations
5	Approximate reals by rationals

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"An introduction to theory of numbers", Niven I., Zuckerman S. H. and Montgomary L. H.John Wiley and Sons .	1991
2	"Theory of Numbers", Hardy and Wright W. H.Oxford University Press	1979
3	"Higher arithmetic", Davenport H.Cambridge University Press .	1999.
4	"Elementary Number Theory", David M. Burton, Wm.C.brown Publishers, Dubuque, Ivova .	1989

Course Name	**:**	**FOURIER SERIES AND INTEGRAL TRANSFORMS**
Course Code	**:**	**MAN 433**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to expand functions in Fourier series, Fourier Integrals and learn Fourier sine and cosine Transforms, Harmonic analysis and their applications. The students should be able to evaluate Laplace transforms and Inverse Laplace transform.

The students should be able to apply Laplace transforms to solve ordinary differential equations.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**Periodic functions, Trigonometric series, Fourier Series, Euler's formulae, Conditions for existence of Fourier series, Functions of any period p = 2L, Even and odd functions, Half range expansions, Complex Fourier series, Applications of Fourier series, Parseval's identity, Harmonic analysis. Approximation by Trigonometric Polynomials**	12
2	Fourier Integral, Fourier Sine and Cosine Integrals ,Evaluation of Integrals, Fourier Transforms, Fourier Cosine Transform, Fourier Sine Transform, Properties of Fourier Transform, Linearity ,Symmetry, change of Time Scale, Time Shifting , Frequency Shifting , Fourier Transform of derivatives, integrals, convolution , Properties of Fourier cosine and sine Transforms, Parseval Identity for Fourier Transform , Finite Fourier Cosine and Sine Transform	18
3	**Laplace transform, Inverse transform, properties, Transforms of derivatives and integrals, s-Shifting ,t-Shifting, Unit step function, Dirac's delta function, Differentiation and integration of transforms, Applications to differential equations. Convolution Theorem ,Integral Equations**	12

Course Outcomes:	
1	By the end of this course the students will be able to expand a function in terms of its Fourier Series ,Fourier Integrals, Fourier Transforms and apply harmonic analysis to numerical data.
2	The students will be able to evaluate Laplace transforms and inverse Laplace transforms.
3	The students will be able to use Laplace transform to solve ordinary differential equations arising in engineering problems.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Higher Engineering Mathematics", B V Ramana, Tata McGraw -Hill	2006
2	"Advanced Engineering Mathematics", E. Kreyszig, John Wiley.	2006
3	"Advanced Engineering Mathematics", Wylie and Barrett, McGraw Hill.	2003

Course Name	**:**	**CALCULUS OF VARIATIONS**
Course Code	**:**	**MAN 434**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of the course the students should be able to understand the concept of functional, extremum, Euler's equations, the concepts of transversality conditions, Weirstress-Endmann corner condition and canonical form of Euler equations, canonical transformations and Rayleigh Ritz method,They should be able to apply direct methods in calculus of variations Euler's finite difference methods, use Rayleigh Ritz method and Sturm-Liouville to solve differential equations.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Variation of a functional. A necessary condition for an extremum, Euler's equation. Some classical problems. Fixed end point problems for unknown functions. Variational problems with subsidary conditions.	10
2	General variation of a functional. Variable end point problems, transversality conditions. Transversal theorem. Weirstress-Endmann corner condition. Canonical form of Euler equations and their first integrals. Canonical transformations. Weather's theorem. The principle of the least action. Censervation laws. Hamilton-Jacobi equations. Jacobi's theorem.	14
3	The second variation of a functional and the formula for second variation. Legendre's necessary condition. Iaoobi's necessary condition. Conjugate points, Sufficient condition for a weak extremum. General definition of a field and field of a functional. Hilberts invariant integral. The weierstrass E-functional. Sufficient conditions for a strong minimum. Direct methods in calculus of variations Euler's finite difference methods and the Rayleigh Ritz method. Applications to sturm-Liouville problem.	18

Course Outcomes:	
1	At the end of the course the students will be able to understand the concept of functional, extremum, Euler's equations.
2	They will be able to learn the concepts of transversality conditions, Weirstress-Endmann corner condition and to evaluate canonical form of Euler equations, canonical transformations and Rayleigh Ritz method.
3	They will be able to apply direct methods in calculus of variations Euler's finite difference methods, use Rayleigh Ritz method and Sturm-Liouville to solve differential equations.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Calculus of variations", I M. Gelfand and S. V. Fomin	1963
2	"Calculus of variations", L.E. Elsgolc.	1962

Course Name	**:**	**ALGEBRAIC CODING THEORY**
Course Code	**:**	**MAN 435**
Credits	**:**	**4**
L T P	**:**	**3-1-0**

Course Objectives:
At the end of this course, the students should be able to translate fundamental problems of coding theory into mathematical problems and then solve them by using the theory of finite fields, polynomial rings and finite groups.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**INTRODUCTION TO CODING THEORY** Source and Channel coding, Error detecting and error correcting codes	2
2	**ERROR DETECTION, ERROR CORRECTION AND DECODING** Communication Channels, maximum likelihood decoding, Hamming distance, Nearest neighbour/ minimum distance decoding, distance of a code	6
3	**FINITE FIELDS** Fields, Polynomial rings, Structure of finite fields, Minimal polynomials	10

4	**LINEAR CODES** Vector spaces over finite fields, Linear Codes, Hamming weight, Bases for linear codes Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes, Cosets, Nearest neighbor decoding for linear codes, Syndrome Decoding, Weight Enumerator of a Code, Macwilliam's Identity,	16
5	**CYCLIC CODES** Definition, Generator polynomials, Generator matrix and parity check matrix, Decoding of linear codes.	8

Course Outcomes: By the end of the course, the students will be able to	
1	Translate fundamental problems of coding theory into mathematical problems and then solve them by using the theory of finite fields, polynomial rings and finite groups.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Coding Theory", San Ling & Chaoping Xing , Cambridge University Press	2004
2	"Introduction to the 'Theory of Error Correcting Codes", Vera Pless, Cambridge University Press	2003
3	"Introduction to Error Correcting Codes", Raymond Hill, Clarendon Press, Oxford	1986
4	"Theory of Error Correcting Codes Part I & II", F.J.Macwilliams & NJA Sloane	1977

Course Name	**:**	**QUANTUM MECHANICS**
Course Code	**:**	**PYN-431**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Blackbody radiation, photoelectric effect, X-rays, X-ray diffraction, Compton effect, Pair production	7
2	Inadequacy of classical physics, Bohr-Sommerfield quantization rules, Quantum-Mechanical viewpoint.	4
3	De Broglie waves, phase and group velocities, particle diffraction, Uncertainty Principle, limitations on experiment, wave packets.	7
4	One-dimensional Schrodinger wave equation, extension to three dimensional statistical interpretation of wave function, Normalization, expectation value.	6
5	Separation of wave equation, one-dimensional square well potential, perfectly rigid wall, finite potential step, tunnel effect.	8
6	Linear harmonic oscillator, three-dimensional square well potential, the hydrogen atom, separation of variables, quantum numbers, principal quantum number, orbital quantum number, magnetic quantum number, Zeeman effect.	10

Course Outcomes: By the end of the course, student will be able to	
1	Solve the problems based on Quantum Mechanics.

2	Apply the concepts of Quantum Mechanics in different phenomena.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Concepts of Modern Physics", Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013
2	"Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	"Modern Physics", J. Bernstein, P.M. Fishbane and S.G. Gasiorowicz, Pearson, Education India Pvt. Ltd., New Delhi	2009

Course Name	**:**	**STATISTICAL PHYSICS**
Course Code	**:**	**PYN-432**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
The students will be able to describe and implement concepts and principles of Statistical Mechanics required for in depth understanding of Physical phenomena in solid state, nuclear physics.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Laws of Thermodynamics - First Law of Thermodynamics, Second Law of Thermodynamics, Entropy, Third Law of Thermodynamics.	6
	Phase Transitions, Kinetic Theory, Vander waal equation of state, Boltzmann transport equation, Maxwell-Boltzman Distribution, the method of most probable distribution.	8
2	Classical Statistical Mechanics, Microcanonical ensemble, Cnonical ensemble, Grand Canonical ensemble, Chemical Potential.	7
	Distribution function, Ideal Fermi Gas, Degenerate and non-degenerate states, Theory of white dwarf stars, Landau Diamagnetism.	7
3	Equation of state for ideal Fermi gas, quantized Hall effect, Pauli paramagnetism, Ideal Bose gas, Bose-Einstein distribution, Derivation of Planck's Law.	7
	Phonons, Specific heat, superfluids, Landau's theory, superfuid flow, superfluid velocity, Bose-Einstein Condensation.	7

Course Outcomes:	
1	Solve the problems based on Statistical Mechanics.
2	Understand the importance of statistical physics in describing various natural phenomena.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Statistical Mechanics" , K. Huang, Wiley India Private Ltd., New Delhi	2013
2	"Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Robert Eisberg and	2013

	Robert Resnick, Wiley India Pvt. Ltd., New Delhi	
3	"Concepts of Modern Physics", Arthur Beiser, McGraw Hill Education (India) Pvt. Ltd., New Delhi.	2013

Course Name	**:**	**NUCLEAR PHYSICS**
Course Code	**:**	**PYN-433**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
The students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Mass, charge and constituents of nucleus, Nuclear size and distribution of nucleons, Energies of Nucleons, Nucleus as a quantum system, nuclear force, properties of nucleus.	10
2	Particle in a one-dimensional square well, particle in a three-dimensional square well, vector model for addition of angular momentum.	10
3	Bound states of two nucleons - Deuteron nucleus, Meson theory of nuclear forces. Shell theory of nucleus, shell theory potential, allowed orbits, filling of allowed orbits, non-spherical nucleus.	10
4	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions.	12

Course Outcomes: By the end of the course, student will be able to	
1	Solve the problems based on Nuclear Physics.
2	Understand and apply the basic concepts of nuclear physics in different nuclear phenomena.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Concepts of Nuclear Physics" , B.L. Cohen, Tata Mcgraw Hill, New Delhi	2013
2	"Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	"Introductary Nuclear Physics", Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014

Course Name	**:**	**EXPERIMENTAL NUCLEAR PHYSICS**
Course Code	**:**	**PYN-434**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course the students should be able to describe and implement concepts and principles of Quantum Mechanics required for in depth understanding of Physical phenomena of materials in relation to applications in Engineering. The students should be able to solve numerical problems related to hydrogen atom.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**Experimental Nuclear Physics** Binding energies of nuclei, semi-empirical mass formula, magnetic dipole moment, electric quadrupole moment, Beta decay, nucleon emission, decay laws.	10
2	Experimental method in nuclear physics, interaction of charged particle with matter, detectors for energetic charged particles, detectors which make tracks visually observable, scintillation detectors, charge collection detectors, mass spectrometer.	10
3	Accelerators, linear accelerator, cyclic accelerator, synchrocyclotron.	10
4	Natural radioactivity, successive radioactive transformations, radioactive equilibrium, radioactive series, radiometric dating. Nuclear force and its characteristics, Elementary description of shell model, explanation of magic numbers, liquid drop model and semi-empirical binding energy formula. Nuclear fission, fission products, mass and energy distribution of fission products, neutron emission and energy distribution of neutrons emitted in fission, theory of fission process, nuclear reactors - classification, neutron cycle in thermal reactors and four-factor formula for neutron reproduction, nuclear fission - controlled thermonuclear reactions.	12

Course Outcomes: By the end of the course, student will be able to	
1	Solve the problems based on experimental Nuclear Physics.
2	Predict that which type of detector or accelerator is suitable for particular application.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Concepts of Nuclear Physics" , B.L. Cohen, Tata Mcgraw Hill, New Delhi	2013
2	"Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles", Robert Eisberg and Robert Resnick, Wiley India Pvt. Ltd., New Delhi	2013
3	"Introductary Nuclear Physics", Kenneth S Krane, Wiley India Pvt. Ltd., New Delhi	2014

Course Name	**:**	**X-Ray Crystallography**
Course Code	**:**	**PYN-435**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of the course, student will become familiar with the applications of X-ray crystallography in the determination of molecular structure. On the basis of structure, student will be able to explain the experimental observed properties.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	Bonding in Solids, Ionic bonding, Covalent, metallic bonding, intermolecular bond, dispersion bond, hydrogen bond.	12

	General features of crystals, basis and crystal structure, unit cell and lattice parameters, external symmetry of crystals, seven crystal systems, thirty two crystal classes, Miller indices, space lattice, symmetry elements, space group.	
2	General description of scattering process, Thomson scattering, Compton scattering, scattering of X-rays by atoms.	10
3	Diffraction from one-dimensional and three-dimensional array of atoms, reciprocal lattice, Ewald sphere, Laue equation, structure factor, Diffraction by periodic distribution, electron-density equation, Patterson method. Powder camera, oscillation camera, Weissenberg camera.	10
4	Relevance of crystallography in the studies of theory of solids, influence of translational periodicity on the physical behavior of solids, tight binding approximation, density of states,	10

Course Outcomes:	
1	Solve the problems based on crystal systems.
2	Apply X-ray crystallography in the determination of molecular structure.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"An introduction to X-Ray Crystallography" by M.M. Woolfson Vikas Publishing House, Cambridge University Press, New Delhi	2012
2	"Solid State Physics", S.O. Pillai, New Age International (P) Limited, New Delhi	2010
3	"Crystallography Applied to Solid State Physics", Verma and Srivastava, New Age International (P) Limited, New Delhi	2012

Course Name	**:**	**INORGANIC CHEMISTRY**
Course Code	**:**	**CHN-431**
Credits	**:**	**4**
L T P	**:**	**3 0 3**

Course Objectives:
At the end of this course, the students should be able to describe concepts of Inorganic chemistry related to structure, properties & applications of inorganic and organometallic compounds.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**QUANTUM THEORY AND ATOMIC STRUCTURE:** Introduction to wave mechanics, the Schrodinger equation, the Schrodinger equation as applied to hydrogen atom, the origin of quantum numbers and shapes of orbitals.	4
2	**CHEMICAL BONDING:** Molecular orbital and valence bond theories of bond formation and application of molecular orbital theory to the formation of homonuclear and heteronuclear diatomic molecules.	7
3	**THE SOLID STATE:** A recapitulation of close packing of spheres, structures of NaCl, CsCl, ZnS, CaF2, crystal defects and applications of defect structures (transistors, rectifiers, photovoltaic cells and computer chips).	4
4	**COORDINATION COMPOUNDS:** Part 1: Werner's theory, effective atomic number, bonding of transition metal complexes: valence bond theory, crystal field theory, crystal field splitting in tetrahedral, octahedral and distorted octahedral (square planar) crystal fields. Thermodynamic aspects of coordination	6

	compounds (crystal field stabilization energies of octahedral and tetrahedral complexes, spectrochemical series).	
5	**COORDINATION COMPOUNDS:** Part2: Kinetic aspects of coordination compounds (substitution reactions in complexes with coordination number 4 and 6 and their mechanism - SN^1, SN^2). Magnetic behaviour of complexes – Para magnetism, diamagnetism, ferromagnetism and antiferromagnetism	6
6	**ORGANOMETALLIC COMPOUNDS:** Nomenclature, types of ligands and bonding in organometallic compounds, use of organometallics in industry.	5
7	**INORGANIC POLYMERS:** Types of inorganic polymers, polyphosphazenes, polysiloxanes –their structures and properties.	5
8	**ROLE OF METALS IN BIOLOGICAL SYSTEMS:** Bio-inorganic Chemistry of Iron – Heme proteins & Non-Heme iron proteins; bioinorganic chemistry of cobalt-vitamin B12 and metalloenzymes.	5

List of Experiments:		**Number of Turns**
1	Estimation of oxalate using potassium permagnate.	1
2	Estimation of Fe^{2+} and Fe^{3+} using potassium dichromate.	1
3	Estimation of Cu^{2+} and AsO_3^{3-} iodimetrically.	2
4	Determination of Zn by EDTA titration.	1
5	Estimation of Ba^{2+}/SO_4^{2-} by as $BaSO_4$ gravimetrically.	1
6	Estimation of Fe^{2+} and Fe^{3+} as Fe_2O_3 gravimetrically.	2
7	Preparation and characterization of inorganic complexes (2 nos.).	2
8	Preparation and characterization of organometallic compound.	1
9	Crystallization techniques for purification of inorganic complexes.	1
10	Melting point determination of few inorganic compounds.	1

Course Outcomes: By the end of this course, the student will be able to:	
1	Understand the structure of atom based on quantum theory, concept of chemical bonding in homo- and hetro-atomic molecules & structure of advanced materials along with their applications in electronic fields.
2	Apply the thermodynamic, kinetic, magnetic and mechanistic aspects to coordination compounds.
3	Develope organometallic compounds to study the interaction and role of metals in biological systems essential for bio-engineering applications.
4	Design new inorganic materials with in-depth understanding of their structures and properties.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Inorganic Chemistry", A. G. Sharpe., 3rd Edition, Longman Publishers ELBS.	1992
2	"Inorganic Chemistry", J. D. Lee, 5th Edition, Chapman and Hall Publishers.	1996
3	"Advanced Inorganic Chemistry", F. A. Cotton & G. Wilkinson,3rd Edition, Wiley Eastern Ltd.	1982
4	"Basic Inorganic Chemistry", F. A. Cotton & G. Wilkinson; Wiley Eastern Ltd.	1987
5	"Inorganic Polymer", J. Mark, R. West & H. Allcock, Prentice Hall, New Jersey Publishers.	1982
6	"Vogel's Qualitative Inorganic Analysis", G. Svehla, 7^{th} Edition Pearson Education.	2002

Course Name	**:**	
Course Code	**:**	

Credits	**:**	
L T P	**:**	

Course Objectives:

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**Ultrasonics** Production, detection and uses of ultrasonics, reverberation, sabine's formula (no derivation)	(3)
2		
3		
4		

List of Experiments:		**Number of Turns**
1		
2		
3		
4		
5		

Course Outcomes:	
1	
2	
3	
4	
5	

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	" Computer Graphics", Donald Hearn and M. Pauline Baker, Pearson Education	2012
2		
3		
4		
5		

Course Name	**:**	**ANALYTICAL CHEMISTRY**
Course Code	**:**	**CHN-433**
Credits	**:**	**4**
L T P	**:**	**310**

Course Objectives:
At the end of this course, the student should be able to develop sufficient knowledge about the major instrumental methods of chemical analysis so that they can determine what technique should be used for study of structural aspects of all kinds of materials. The student will be able to analyze the advances in instrumentation which have been made, especially those made as a result of problems encountered with the method. Students will gain practical

knowledge of experimental methods and analytical instrumentation for carrying out analytical separations using gas and liquid chromatography.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**COMPLEXOMETRIC TITRATIONS :** Complexes-formation constants; chelates – EDTA, Chelon Effect, EDTA equilibria, effect of pH on EDTA equilibria, EDTA titration curves, endpoint – detection and indicators; Importance of complexometric titrations.	4
2	**SOLVENT EXTRACTION :** Distribution law, extraction process, factors effecting extraction, technique for extraction, quantitative treatment of solvent extraction equilibria, and classification of solvent extraction systems. Advantages and applications of solvent extraction.	6
3	**CHROMATOGRAPHY:** Introduction to chromatography, principles, classification of chromatographic techniques, thin layer and paper chromatography – principle and technique. Column Chromatography – Factors affecting column efficiency and applications. Gas – liquid chromatography – theory, instrumentation and applications. HPLC – instrumentation, method, column efficiency and applications.	8
4	**THERMOANALYTICAL METHODS :** Principle, classification of methods. TGA –Instrumentation, factors affecting results and analysis of data. Applications. DTG – Instrumentation, analysis of data and applications. DTA – Principle, Instrumentation and applications.	8
5	**SPECTROSCOPIC TECHNIQUES:** UV Introduction to spectroscopy, Lambert Beer s law, instrumentation and applications ,IR Introduction, basic principles, factors affecting IR group frequencies , Instrumentation and Applications ,NMR Basic principles, elementary ideas and instrumentation chemical shifts, spin-spin coupling.	10
6	**ELECTRON MICROSCOPY:** Scanning electron microscopy (SEM), Transmission Electron Microscopy (TEM) and Scanning Transmission Electron Microcopy (STEM) Principles and Applications	6

Course Outcomes: By the end of this course, the student will be able to:	
1	Address the problems of analyzing complex samples. This would include defining the problem, determining any constraints, choosing the best methodology, and determining how to test the methodology to prove its merits. Where there are alternatives the student should be able to define the advantages and disadvantages of each.
2	Interpret data from analytical separation methods and will understand approaches for the validation of these analytical.
3	Carry out hands on experiments in the field related to analysis of materials required for technological developments and in advanced research in Engineering.
4	Apply various analytical techniques for analysis of organic and inorganic materials.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Principles of Instrumental Analysis", by Skoog, D. A. & West D. M., 5th Edition, Saunders College Publishers, USA.	1998
2	"Fundamentals of Analytical Chemistry", Skoog, D. A. & West D. M., 7th Edition, Saunders College Publishers, USA.	2000
3	"Industrial Methods of Analysis", Willard, Merritt, Dean &Settle, 7th Edition.	1989

4	"Industrial Methods of Chemical Analysis", Galen W. Ewing, 5th Edition.	1985
5	"Spectrometric identification of Organic Compounds", Silverstein R. M. &Webster F.X., 6th Edition, John Wiley and Sons, Inc., USA	2005
6	"Quantitative Inorganic Analysis", A.I, Vogel, 5th Edition.	1989

Course Name	**:**	**ENVIRONMENTAL CHEMISTRY**	
Course Code	**:**	**CHN-434**	
Credits	**:**	**4**	
L T P	**:**	**3 1 0**	

Course Objectives:
At the end of this course, the student should be able to understand the basic knowledge of environmental chemistry, such as chemistry of atmosphere, hydrosphere, pedosphere and biosphere. The student will be able to apply basic theories and methods of chemistry to study the environmental issues caused by chemical substances (pollutants).

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	CHEMICAL COMPOSITION OF AIR : Classification of elements, chemical speciation. Particles, ions, and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Sources of trace gases in the atmosphere; Thermo-chemical and photochemical reactions in the atmosphere. Tropospheric oxidation chemistry; Oxygen and ozone chemistry. Chemistry of air pollutants. Role of hydrocarbons; Sulphur chemistry; Halogen Chemistry in the atmosphere.	8
2	WATER CHEMISTRY: Chemistry of water, dissolution / precipitation reactions; complexation reactions; concept of DO, BOD, COD; concept of salinity; composition of sea water and physic-chemical speciation in oceans; Suspended particles; concept of sedimentation, coagulation, filtration,	8
3	SOIL POLLUTION : Pollutants in soil, Agricultural Pollution, Role of Micro nutrients in soil, Ion exchange reaction in soil, Pesticide (Classifications & Degradation), Path of Pesticides in Environment, Monitoring techniques.	8
4	ENVIRONMENTAL TOXICOLOGY AND ITS EVALUATION: Emergence as a science; concepts and definitions; Factors affecting toxicity, Evaluation of LC50, LD50, LCIC and IT.	5
5	TOXIC CHEMICAL IN THE ENVIRONMENT : Metals and other inorganic contaminants; Organic contaminants; Fate of organic contaminants; Pesticides; Biochemical aspects of arsenic, cadmium, lead, mercury, carbon monoxide, ozone and PAN Pesticides; Insecticides, MIC, carcinogens in the air. Photochemistry of Brominated Flame Retardants (BFR) Gene toxicity of toxic chemicals.	8
6	GREEN CHEMISTRY FOR SUSTAINABLE FUTURE : Reagents, Media, Special Importance of Solvents, Water the Greenest Solvents, Synthetic and Processing Pathways, Role of Catalyst, Biological Alternatives, Biopolymers, Principles and Application of Green Chemistry.	5

Course Outcomes: By the end of this course, the student will be able to:	
1	Describe the chemical composition (and the main elements' occurrence forms) of the geosphere, the atmosphere, the hydrosphere, and the biosphere and to explain how interactions between these spheres and the techno sphere affect the environment.
2	Know the basic chemical features of some environmental concerns of today and their societal origin, with

	specific focus on acidification, eutrophication, ozone, nuclear wastes, heavy metals, organic pollutants, and climate change issues.
3	Develop integrated technologies to support the recycling of carbon and plant nutrients from agricultural crops, bio-based industries and municipal water treatment plants.

Suggested Books:		
Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"Environmental Chemistry", Banerji, S.K, 2nd Edition, Prentice-Hall, New Delhi, India.	1999
2	"Environmental Chemistry", A. K. De, 4th Edition, New Age International (P) Ltd., New Delhi, India.	2000
3	"Introductory Chemistry for the Environment Science", Harrison, R. M. and de Mora, S. J. 2nd Edition, Cambridge University Press, New Delhi.	1996
4	"Introduction to Atmospheric Chemistry", Hobbes, P.B. Cambridge University Press, UK.	2000
5	"Principles of Environmental Chemistry", Kothandaaman, H. and Swaminathan, G. B.I. Publications, Chennai, India.	1997
6	"Fundamentals of Environmental Chemistry", Manahan, S. E. 2nd Edition, CRC Press, Inc., USA.	2001

Course Name	**:**	**RECENT ADVANCES IN CHEMICAL SCIENCES**
Course Code	**:**	**CHN-435**
Credits	**:**	**4**
L T P	**:**	**3 1 0**

Course Objectives:
At the end of this course, the student should be able to use molecular building blocks to design functional supramolecular constructs and nano-structured materials by using the principles of Supramolecular Chemistry. The student will be able to understand chemical and physical phenomena particular to surfaces and interfaces and reduce chemical pollutants flowing to the environment by using principles of Green Chemistry.

Total No. of Lectures – 42

Lecture wise breakup		**Number of Lectures**
1	**SUPRAMOLECULES:** Concepts of supramolecular chemistry- Thermodymanics of molecular recognition, solvation, multivalency, Molecular Recognition: Cations,Anions and Neutral guests, Self processes - Self-assembly, Supramolecular -devices and Sensors, Molecular logic, photo switching materials, Supramolecular -material Chemistry Crystal engineering, MOFs and coordination polymers, templates for biomineralisation	8
2	**CHEMISTRY OF NANOMATERIALS:** Synthesis of nanoparticles by chemical routes and characterization techniques: Thermodynamics and kinetics of nucleation; Growth of polyhedral particles by surface reaction, Ostwald ripening, size distribution; Properties of nanostructured materials : Optical properties; magnetic properties;	9
3	**HOMOGENEOUS CATALYSIS :** Stoichiometric reaction for catalysis, homogeneous catalytic hydrogenation, Zeigler-Natta polymerization of olefins, catalytic reations involving carbon monoxide such as hydrocarbonylation of olefins (oxo reaction) oxopalladation reactions, activation of C-H bond.	8
4	**SURFACTANT AGGREGATION:** Micelles, Surface active agents, Classification of surface active agents, Micellization,	9

	Hydrophobic interaction, Critical micellar concentration (cmc), Factors affecting the concentration of surfactants, Counter-ion binding of micelle, Thermodynamics of micellization, Phase separation and Mass action models, Solubilization Emulsions, Mechanism of formation of microemulsion and their stability, Phase maps, Physical techniques, Applications..	
5	**GREEN CHEMICAL PROCESSES:** An introduction to the tools of green chemistry and its fundamental principles. Use of Renewable Raw Materials. Evaluating feedstock and starting materials -commodity chemicals from glucose Greener Solvents: The use of supercritical fluids, and aqueous systems Greener reagents and products. Methods of designing safer chemicals Examples of greener reagents replacement of phosgene, methylations using dimethylcarbonate,	8

Course Outcomes: By the end of this course, the student will be able to:	
1	Exploit supramolecular engineering to design structures with adapted morphologies and properties.
2	Initiate self-assembly processes in bimolecular systems and the basis of bio-inspired chemistry.
3	Understand the interactions between surfaces and gases, liquids or solutions, and how interfaces are important in many technological a biological processes..
4	Identify the new advancements and approaches of chemical sciences for technological leads in various fields of sciences and Engineering.

Suggested Books:

Sr. No.	**Name of Book/ Authors/ Publisher**	**Year of Publication/ Reprint**
1	"The Organometallic Chemistry of the Transition Metals", Crabtree, R.G. 4th Edition, John Wiley.	2005
2	"Wilkinson Advanced Inorganic Chemistry", Cotton, F.A.; 6th Edition, John Wiley.	1999
3	"Supramolecular Chemistry",Steed J. W. and Atwood J. L., John Wiley and Sons, Ltd.	2000
4	"Green Chemistry and Catalysis",Roger Arthur Sheldon, Dr. Isabel W. C. E. Arends, Dr. Ulf Hanefeld, Wiley-VCH Verlag GmbH & Co. KGaA.	2007
5	"Physical Chemistry of Surfaces", Adamson A.W., Pubs: John Willey, New York.	1982
6	"Surfactant Science and Technology", Myers D., Pubs: VCH Publishers.	1988