SGGS INSTITUTE OF ENGINEERING & TECHNOLOGY,

VISHNUPURI, NANDED

T.Y. B.Tech. (Instrumentation Engineering) Curriculum Structure: CBCS, (Effective from Academic year 2016-17)

Semester V						
Course Code	**Course Title**	**Lectures (L)**	**Tutorials (T)**	**Practical (P)**	**Credits**	
					Th.	**Pr.**
IN301	Feedback Control Systems	3	1	2	4	1
IN302	Industrial Instrumentation	3	-	2	3	1
IN303	Digital Signal Processing	3	-	2	3	1
IN304	Microprocessor and Microcontroller	3	1	2	4	1
IN305	Industrial Data Communications	3	-	-	3	-
IN306	Unit Operations and Instrumentation	3	-	-	3	-
Total		**18**	**01**	**08**	**24**	

Semester VI						
Course Code	**Course Title**	**Lectures (L)**	**Tutorials (T)**	**Practical (P)**	**Credits**	
					Th.	**Pr.**
IN307	Process Control	3	-	2	3	1
IN308	Control System Components	3	-	2	3	1
IN309	Distributed Control System	3	1	2	4	1
IN310	Power Electronics	3	-	2	3	1
IN311	Power Plant Instrumentation	3	-	-	3	-
IN312	Elective – II	3	-	-	3	-
IN313	Seminar	-	-	2	-	1
HU301	Humanity Science	2	-	-	Audit	
Total		**18**	**01**	**10**	**24**	

Elective – II

IN312 (I) : Digital System Design
IN312 (II) : Optical Instrumentation
IN312 (III) : Automotive Instrumentation
IN312 (IV) : Mechatronics
IN312 (V) : Material Science
IN312 (VI) : Microelectronics
IN312(VII) : Data Structure and Algorithms

CONTENTS

Semester-V

IN301 Feedback Control Systems

Teaching scheme:			Examination scheme:
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	1	hrs/week	
Practical	2	hrs/week	
Credits	5		

Course objectives:

1.	To study the concept of time response and frequency response of the system.
2.	To teach the fundamental concepts of control systems and mathematical modeling of the system.
3.	To introduce and teach the iterative nature of most designs in order to achieve working systems.

Syllabus:

Unit 1	**Introduction to control systems**
	Definition, history, elements of control systems, examples of control systems, open- loop (non feedback) and closed loop (feedback) control systems, effect of feedback on overall gain, parameter variations, external disturbances or noise and control over system dynamics, regenerative feedback, linear versus nonlinear control systems, time- invariant versus time- varying systems, SISO and MIMO systems.
Unit 2	**Mathematical modeling of dynamic systems**
	Introduction, canonical form of feedback, control systems, transfers function and impulse response. differential equations and transfer functions of physical systems such as mechanical, electrical, electromechanical, thermal, pneumatic and liquid-level systems, analogous systems, force-voltage, force-current and torque- current analogies, loading effects in interconnected systems, systems with transportation lags, linearization of nonlinear mathematical models, block diagram representation of control system, rules and reduction techniques, signal flow graph: elements, definition, properties, masons gain formula, application of gain formula to block diagrams.
Unit 3	**Time- domain analysis of control systems**
	Standard test signals, transient response, steady state error and error constants, dynamic error series, time response of first and second order systems and transient response specifications, effect of adding poles and zeros to transfer functions, dominant poles of transfer function, basic control actions and response of control systems, effects of integral and derivative control action on system performance, higher order systems.
Unit 4	**Stability of linear control systems**
	Concept of stability, BIBO stability: condition, zero input and asymptotic stability, Hurwitz stability criterion, Routh-Hurwitz criterion in detail, relative stability analysis.
Unit 5	**The Root–Locus technique**
	Introduction, basic properties of the root loci, general rules for constructing root loci, Root- Locus analysis of control systems, Root loci for systems with transport lag, Root-contour plots, sensitivity of the roots of the characteristics equation.

Unit 6	**Frequency domain analysis**
	Frequency response of closed loop systems, frequency domain specifications of the prototype second order system, correlation between time and frequency response, effect of adding a pole and a zero to the forward path transfer function, polar plots, Bode plots, phase and gain margin, stability analysis with Bode plot, log magnitude versus phase plots. Constant M and N circles, Nichols chart, gain adjustments, sensitivity analysis in frequency domain, Nyquist stability criterion: mathematical preliminaries, stability and relative stability analysis.
Unit 7	**Compensators**
	Introduction, different types of compensators (Electrical, Electronic and Mechanical type), their transfer functions.
Reference Books:	
1.	K. Ogata, "Modern Control Engineering", Fourth Edition Pearson education India, 2002.
2.	B. C. Kuo, "Automatic control systems", Seventh Edition, Prentice –Hall of India, 2000.
3.	Norman S. Nise, "Control systems Engineering", Third Edition, John Wiley and Sons. Inc, Singapore, 2001.
4.	R. C. Dorf and R. H. Bishop, "Modern Control systems", Eighth Edition, Addison Wesley, 1999.
5.	I. J. Nagrath and M. Gopal, "Control systems Engineering", Third Edition, New age International Publishers, India, 2001.
Course outcomes:	
1.	To exhibit the capability to represent the mathematical model of a system and to determine the response of different order systems for various standard inputs.
2.	To demonstrate the ability to apply Laplace transform, transfer functions, modeling RLC circuit, block diagrams for simulation and control.
3.	To specify control system performance in the frequency-domain and design compensators to achieve the desired performance.
4.	To validate what they have learned theoretically in the field of control system engineering.
5.	To gain some practical experience in control engineering which might become a future research point for them.
6.	To construct and recognize the properties of root-locus for feedback control systems with a single variable parameter.
Term Work:	
It will consist of at least eight experiments/assignments/programs from the following list:	
1.	Determination of transfer function of an armature controlled d. c. motor.
2.	Determination of transfer functions of D. C. generator.
3.	Effect of feedback on D. C. generator.
4.	Transient response of second order system.
5.	Study of D. C. positional servo system.
6.	Study of A. C. servo voltage stabilizer.
7.	Study the performance of an open and closed loop control system using electronic amplifiers using OPAMPs.
8.	Study the performance of a second order system (Use any OPAMP based

	electronic system such as an active second order Butterworth filter).
9.	Study the performance of any first order and second order system.
Experiments based on software (programs)	
1.	Introduction to MATLAB, MATLAB's simulink and control systems toolbox (with some examples) or any other control system related software package.
2.	Compare and plot the unit-step responses of the unity-feedback closed loop systems with the given forward path transfer function. Assume zero initial conditions. Use any computer simulation program.
3.	Study of effect of damping factor on system performance by obtaining unit step response and unit impulse response for a prototype standard second order system. Consider five different values for x = 0.1, 0.3, 0.5, 0.7 and 1.0. Also study the effect of varying undammed natural frequency by taking three different values. Comment on the simulations obtained.
4.	Write a program that will compute the step response characteristics of a second order system i.e. percent overshoot, rise time, peak time and settling time. Generalize it for accepting different values of undammed natural frequency and damping factor.
5.	Study and plot the unit step responses of addition of a pole and a zero to the forward path transfer function for a unity feedback system. Plot the responses for four different values of poles and zeros. Comment on the simulations obtained.
6.	Study and plot the unit step responses of addition of a pole and a zero to the closed loop transfer function. Plot the responses for four different values of poles and zeros. Comment on the simulations obtained.
7.	Program for compensator design using Bode plot.
8.	Program for compensator design using Root Locus analysis.
9.	Plot and comment on various properties of any three systems (problems) using • Routh-Hurwitz criterion • Root locus technique • Bode plots • Nyquist plots Use any software package.

IN302 Industrial Instrumentation			
Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	4		

Course objectives:	
1.	To get an adequate knowledge about various techniques used for various parameters measurement in industries and select the proper transducer.

2.	To provide exposure to various state of art process parameters measuring transducers and their selection procedures.
3.	To understand, analyze and design various measurement schemes that meet the desired specifications and requirements of real time processes.
Syllabus:	
Unit 1	**Temperature sensor selection and applications**
	Design of temperature instrumentation system using RTD, thermocouple, thermistor, selection criteria, self heating effects in resistive temperature transducers, power-dissipation constant and its calculations, thermocouple with thermowell assembly, time-constant calculation, protection-tubes, types, materials, design considerations for thermowell, types, manufacturing process of T/C, RTD, thermistor, testing of RTD as per the standard. Radiation measurement: radiation thermometers, introduction, definition of terms, general form of radiation measurement system, radiation thermometer types, photo electric radiation thermometers, signal conditioning for radiation thermometers, remote reading thermometers. Sensor calibrators and simulators.
Unit 2	**Pressure measurement**
	Basics, mechanical type instruments, electromechanical type, low pressure measurement, related accessories, pressure measuring standards, selection and application. Transmitter definition, classification, pneumatic transmitter-force balance type, torque balance type, two wire and four wire transmitters, I/P and P/I converters. Design of pressure instrumentation using diaphragm, bourdon tubes and bellows.
Unit 3	**Flow measurement**
	Design of flow instrumentation using orifice, rotameter, venturimeter, different flow coefficient like Cd Cc, and Cv and their calculation. Types of orifice designs, Types of pressure taps to measure Dp, design of orifice used in tank outflow and pipe-flow measurements, different design considerations in orifice, venturimeter and rotameter design. Anemometers: Hot wire/hot film anemometer, laser doppler anemometer (LDA), electromagnetic flow meter, turbine and other rotary element flow meters, ultrasonic flow meters, doppler flow meters, cross correlation flow meters, vortex flow meters. Measurement of mass flow rate: radiation, angular momentum, impeller, turbine, constant torque hysteresis clutch, twin turbine coriolis, gyroscopic and heat transfer type mass flow meters. Target flow meters, V-cone flow meters, purge flow regulators, flow switches, flow meter calibration concepts, flow meter selection and application.
Unit 4	**Level measurement**
	Introduction, float level devices, displacer level detectors, rotating paddle switches, diaphragm and differential pressure detectors, resistance, capacitance and RF probes, radiation, conductivity, field effect, thermal, ultrasonic, microwave, radar and vibrating type level sensors. Level sensor selection and application.
Unit 5	**Strain measurement**
	Strain gauge and design of piezo-electric crystal, analysis of piezo-electric crystal for its use in dynamic measurement, time-constant of crystal assembly along with cable and amplifier, calculation of crystal capacitance. Applications

	of strain gauge in various industries.
Unit 6	**Measurement of viscosity**
	Definitions, units, Newtonian and Non-Newtonian behavior, measurement of viscosity using laboratory viscometers, industrial viscometers. Viscometer selection and application.
Unit 7	**Measurement of density**
	Definitions, units, liquid density measurement, gas densitometers, its application and selection.
Unit 8	**Electromagnetic compatibility**
	Introduction, interference coupling mechanism, basics of circuit layout and grounding, concepts of interfaces, filtering and shielding. Safety: introduction, electrical hazards, hazardous areas and classification, nonhazardous areas, enclosures-NEMA types, fuses and circuit breakers. Protection methods: purging, explosion proofing and intrinsic safety. Specification of instruments, preparation of project documentation, process flow sheet, instrument index sheet, instrument specifications sheet, panel drawing and specifications, instrument specifications. Project procedure, schedules, vendor drawing, tender documentation, selection of measurement method and control panels.
Unit 9	**Control panel design**
	Design considerations, type of control panel designs, ergonomics in design of control, control room layout, cabling, wiring details.
Text Books:	
1.	Nakra Chowdhari, "Instrumentation", Prentice Hall of India, New Delhi.
2.	Considine D. M., "Process Instrumentation, and Control Handbook", McGraw Hill International.
3.	Doeblin E. O. and D. Mannik, "Measurement Systems" Fifth Edition, Application and Design, McGraw Hill International Edition, 2006.
4.	Bentley J. P., "Principles of Measurement Systems" Third Edition, Pearson Education, New Delhi, 2000.
5.	Sawhney A. K. and Puneet Sawhney "A Course in Mechanical Measurements and Instrumentation" Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998.
Reference Books:	
1.	Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001
2.	Johnson C. D., "Process Control Instrumentation Technology", Seventh Edition, Pearson Education, New Delhi, 2003.
3.	Warren Boxleitner, IEEE press: Electrostatic Discharge and Electronic Equipment.
4.	Walter C Bosshart , "Printed Circuit Boards", CEDT Series, Tata McGraw Hill.
5.	S. Soclop, "Applications of Analog Integrated Circuit", Prentice Hall of India.
6.	Ott , "Noise Reduction Techniques".
7.	Andrew Williams, "Applied Instrumentation in the Process Industries" Vol. I and Vol. II, GWF Publishing Company.
Course outcomes:	
1.	To recall the knowledge of temperature transducers like, thermocouples, thermistors, RTDs, pyrometry and other temperature measuring techniques.
2.	To understand the construction and working principle of various type of transducers/sensor to measure physical quantities.

3.	To apply the adequate knowledge of pressure and strain transducers.
4.	To analyze, formulate and select suitable sensor/transducer for the given industrial applications.
5.	To demonstrate working knowledge of safety practices used in the measurement and control of industrial processes.
6.	To develop skills to trouble shoot the problems with measurement and control of industrial processes.
Term Work:	
The term work shall consist of a record of at least eight experiments/designs and drawings based on the syllabus given above. Some of the experiments may be from the following list.	
1.	**Case study:** One lab instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2.	Design of a mini project like design of instrument/electronic device/ transducer/instrumentation component/system, its procedure starting from preparation of specifications, designing, testing, and erection. Drawings dimensional sketches, circuit diagram, details of different component on drawing sheet, testing its specifications, determining practical static and dynamic characteristics.

IN303 Digital Signal Processing

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	4		

Course objectives:	
1.	To provide better understanding of discrete-time and digital signal in time and frequency domain
2.	To provide knowledge to analyze linear systems with difference equations.
3.	To design and implement FIR and IIR filters with different structures.
Syllabus:	
Unit 1	**Introduction**
	Discrete time signals and systems, time domain characterization of discrete time LTI systems, sampling theorem, benefits and limitations of processing signal digitally. Correlation of signals. The Z-transform: inverse Z-transform and Z-transform properties for one-sided and two-sided z-transforms. Discrete Time Fourier Transform (DTFT) and its properties.
Unit 2	**LTI Discrete Time Systems in transform domain**
	The frequency response, the transfer function, types of transfer functions, All pass transfer function, minimum-phase and maximum-phase transfer functions, inverse systems.
Unit 3	**Discrete Fourier Transform**
	Discrete Fourier Transform (DFT) and its properties. Computation of DFT (FFT algorithms), Decimation-In-Time (DIT), Decimation-In-Frequency (DIF) and radix-n algorithms of FFT.
Unit 4	**Digital filter structures**

	Digital filter structures: block diagram representation, equivalent structures, basic FIR structures, basic IIR structures, All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures.
Unit 5	**Digital filter design IIR filter design**
	Bilinear transformation, impulse invariant transformation, Lowpass IIR digital filters, spectral transformations, FIR filter design using windowing techniques, frequency sampling technique, and computer aided design.
Unit 6	**Digital Signal Processor**
	Harvard architecture and modified Harvard architecture. Introduction to fixed point and floating point DSP processors, architectural features, computational units, bus architecture and memory architecture, data addressing, address generation unit, pipelining, on-chip peripherals.
Reference Books:	
1.	E. C. Ifeachor, B. W. Jarvis, "Digital Signal Processing- A Practical Approach", Second Edition, Pearson Education, New Delhi, 2002.
2.	S. K. Mitra, "Digital signal processing- A computer based approach", Tata McGraw Hill, 2002.
3.	A. V. Oppenheim, R, W, Schafer, "Discrete time signal processing", Prentice-Hall of India, 2001.
4.	J. G. Proakis, D. G. Manolakis, "Digital signal processing –Principles, algorithms and applications", Prentice Hall of India, 2002.
5.	R. G. Lyons, "Understanding Digital Signal Processing", Pearson Education New Delhi, 1999.
Course outcomes:	
1.	To understand benefits and limitations of processing signals digitally.
2.	To represent and analyze the discrete-time signals in the frequency domain, Discrete-Time Fourier Transform (DTFT), z-transform and Discrete Fourier transform (DFT).
3.	To implement DFT using Fast Fourier Transform (FFT) algorithms, as well as some of its applications (computation of convolution sums, spectral analysis).
4.	To design and implement FIR and IIR filters.
5.	To understand the issues and difficulties in implementation of digital systems.
6.	To propose and design a digital system for day-to-day application.
Term Work:	
Term work shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list. Students are supposed to write the programs (at least eight) on general-purpose computer using any development environment (C/C++/Matlab) or on any DSP processor and development environment.	
1.	Digital signal generation.
2.	Simple operations on signals.
3.	Linear Convolution.
4.	Discrete time Fourier transforms.
5.	Discrete Fourier Transform - Direct computation, DIT algorithm, DIF algorithm.
6.	FIR filters design and software realization by windowing and Frequency sampling.
7.	IIR filter design and software realization of Butterworth and Chebyshev approx.
8.	Any other experiment decided by the teacher.

IN304 Microprocessor and Microcontroller

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	1	hrs/week	
Practical	2	hrs/week	
Credits	5		

Course objectives:

1.	To teach the students to familiarize with microprocessor and microcontroller architecture and functioning.
2.	To train the students to program the microprocessor and microcontrollers for any application.

Syllabus:

Unit 1	**Introduction to 8085**
	Architecture and operation, pin out diagram. Assembly language programming for 8085 microprocessor, instruction classification, instruction set study in details, addressing modes, writing assembly language programs, stacks subroutines, instruction set timing diagrams, a minimum configuration for 8085, interrupt structure of 8085, internal interrupt circuit, hardware and software interrupts.
Unit 2	**Interfacing memories to 8085**
	Interfacing memories EPROM and RAM with 8085 with exhaustive and partial decoding techniques.
Unit 3	**Peripheral devices used in 8085 systems**
	Following structure programmable peripheral devices are to be studied in details as regards block diagram, software for their interfacing with 8085: 8255, 8253, 8279, ADC.
Unit 4	**Introduction to microcontrollers**
	8051 Architecture, pin out diagram, 8051 oscillator and clock, Program counter and Data pointer, A and B CPU registers, flags and PSW, internal memory, stack and stack pointer, SFRS, internal ROM, I/P and O/P ports.
Unit 5	**Programming 8051**
	Assembly language programming for 8051 microcontroller, instruction classification, instruction set Arithmetic and Logical operations, jump and call instructions etc., writing assembly language programming based on instruction set, stacks and subroutines.
Unit 6	**Timers in 8051**
	Interrupts of 8051, counters and timers, timer modes, timer/counter programming.
Unit 7	**Interfacing peripherals to 8051**
	8051 microcontroller interfacing with: keyboard and display, A/D and D/A chips.
Unit 8	**Design of 8051 based systems**
	Design of dedicated systems using 8051 for temperature indication OR/AND control, flow indication, OR/AND control, stepper motor control, embedded control systems, Smart transmitters.
Unit 9	**Serial data transmission**

	Introduction to serial data transmission methods.
Text Books:	
1.	K. L. Short, "Microprocessor and programming logic", Second Edition, Prentice-Hall India Pvt. Ltd.
2.	R. S. Gaonkar, "Microprocessor Architecture, Programming and application with 8085/8085A", Fourth Edition, Willey Eastern Ltd.
3.	B. Ram, "Fundamentals of microprocessor and Microcomputer", Dhanpat Rai and Sons, Eighth Edition, New Delhi.
4.	Ayala K. J., "8051 Microcontroller: Architecture, Programming and applications" Second Edition, Penram international.
5.	Muhammad Ali Mazidi, Janice G. Mazidi and Rolin D. McKinlay, "The Microcontroller and Embedded Systems", Second Edition, Pearson, 2012.
Reference Books:	
1.	B. Ram, "Advanced Microprocessor and Interfacing" Tata McGraw-Hill Publishing Company Ltd., First Edition, New Delhi.
2.	Ajit Pal, "Microprocessor Principles and Applications", Tata Mc-Graw Hill, First Edition New Delhi.
3.	U. V. Kulkarni and T. R. Sontakke, "The 8085A Basics: Programming and Interfacing", Sadusudha Prakashan, First Edition, Nanded.
4.	Intel Mcs, "8085 users manual", Intel Corporation.
5.	Myke Predko, "Programming and customizing the 8051 Microcontroller", Tata McGraw-Hill, First Edition, New Delhi.
6.	N.G. Palan, "8031 Microcontroller – Architecture, Programming and Hardware Design", Technova publishing House.
Course outcomes:	
1.	To describe basics of 8085, 8051 and its instruction set.
2.	To understand historical development of microcontrollers and to know different 8, 16, 32 bit microcontrollers.
3.	To solve assembly language programs based on the instruction set of 8085 and 8051.
4.	To get insight of 8051 based hardware system and so to study ADC, keyboard etc.
5.	To execute assembly language programs based on the instruction set of 8051
6.	To develop 8085, 8051 based instrumentation system.
Term Work:	
It will consist of a record of at least eight of the following experiments based on the Prescribed syllabus.	
1.	Study of Dyralog 8085 kit.
2.	Writing simple programs based on 8085 Instruction set.
3.	Write a program to find largest number from a series of numbers.
4.	Write a program to transfer a block of data.
5.	Write a program for arranging numbers in ascending / descending order.
6.	To study interfacing of 8255 with LEDs, 7-Segment display.
7.	To study interfacing of 8255 with Keyboard, ADC.
8.	To study 8051 Simulator.

9.	To write simple programs using 8051 simulator like- a. Finding largest/smallest number. b. arranging numbers in ascending / descending order. c. Arithmetic of 16-bit numbers.
10.	Interfacing of stepper motor with microcontroller.
11.	Mini project based on 8051.

IN305 Industrial Data Communications

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:

1.	To introduce the principles of analog and digital communication systems involving different modulation and demodulation schemes.
2.	To provide insight about networks, topologies, and the key concepts used in instrumentation industries.
3.	To gain comprehensive knowledge about the layered communication architectures (OSI and TCP/IP) and its functionalities.
4.	To understand the principles, key protocols, design issues, and significance of each layers in ISO and TCP/IP.
5.	To know the basic concepts of network security and its various security issues related with each layer.

Syllabus:

Unit 1	**Communication concepts**
	A. Serial and parallel transmission, data organization: signals, digital standard signals, data organization: communication codes, data organization: error coding, data organization: Protocol concepts. **B. Amplitude modulation** AM wave equation, spectrum, power relation, generation methods, high-level modulation, and low-level modulation, DSBSC and SSB modulation, SSB generation methods, ISB, VSB. **C. Frequency modulation** Mathematical representation of FM, frequency spectrum of FM, generation methods of FM (Direct, Indirect methods), effect of noise on FM, noise triangle, pre-emphasis and de-emphasis, phase modulation, compare AM, FM, PM, Frequency Division Multiplexing.
Unit 2	**Communications models**
	ISO OSI model, mail analogy, OSI model, IEEE 802 models.
Unit 3	**Serial communication standards**
	Basic concepts, TIA/EIA standards, interface signal functions, PC serial communications.

Unit 4	**Local Area Networks**
	Layer 1 the physical layer, topologies, transmission media, 802 and industrial LANs, wireless LANs 802.11, Hub, Bridge, Ethernet Switch, Router, IEEE 802.3/Ethernet: A Layer1 and 2 Standard 10BASE5, 10BASE2, 10BASE-T, 10 GbE-10 Gigabit Ethernet Over Fiber, 10 GbE-10 Gigabit Ethernet Over Copper.
Unit 5	**Industrial networks and field buses**
	Industrial network requirements, HART, ControlNet, EtherNet/IP, PROFIBUS/PROFINET, Foundation Fieldbus, Ethernet-TCP/IP, Modbus RTU Protocol, IEC 61850.
Unit 6	**Wide Area Networks**
	Wireline transmission, carrier concepts, wireline modems, modem types, WAN digital lines, cable modems, WANs for mobile and the hinterlands.
Unit 7	**Internetworking**
	Layer 2: internetworking equipment, Layer 3 devices, Routing topologies, managed switches, gateways.
Unit 8	**Cybersecurity**
	Overview, security vulnerabilities, methods of attack, risk analysis, IACS countermeasures, firewalls, network address translation, monitoring network traffic, hardening, internet and VPN countermeasures, network management and security, IEC/ANSI/ISA-62443 cybersecurity standards, ISA secure certification program.
Reference Books:	
1.	G. Kennedy, Electronic Communication Systems, McGraw Hill, New Delhi.
2.	Lawrence M. Thompson and Tim Shaw, “Industrial Data Communications”, ISA Fifth Edition.
3.	D. Roddy and J. Coolen, Electronic Communications, Prentice-Hall of India Private Limited, Third Edition, 1984.
4.	A. S. Tanennbaum, “Computer Networks”, Fourth Edition, Prentice Hall of India, New Delhi, 2002.
5.	W. Stallings, “Data and Computer communication, Sixth Edition, Pearson Education, New Delhi, 2001.
6.	Comer, “Computer Networks and Internets”, Second Edition, Pearson Education, 2001.
7.	Behrouz A. Forouzen, “Data Communication and Networking” Fourth Edition, McGraw Hill Publications, 2007.
Course outcomes:	
1.	To remember and describe how the physical, data link, and network layers operate in a typical data communication system.
2.	To understand the setting of a network environment with all the necessary data communication components, procedure, conflicting issues and resolution techniques that make it functional.
3.	To apply the operation and technique of various communication protocols such as multiple access protocols, TCP, UDP, FTP, etc.
4.	To analyze the services and features of the various layers of data networks.
5.	To evaluate communication protocols for route calculations and be able to perform such calculations of data transmission.
6.	To create the suitable transmission route for different internetworking devices.

IN306 Unit Operations and Instrumentation

Teaching scheme:			Examination scheme:
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:

1. This is a course that intends to expose the non-specialist student to the broad spectrum of unit operations in the engineering field.

Syllabus:

Unit 1	**Introduction**
	Unit operation and unit process concept: block diagram of chemical process, classification of unit operation, material and energy balance, batch and continuous process, endothermic and exothermic reaction, reversible and irreversible process.
Unit 2	**Heat transfer**
	Importance of heat transfer, principles of heat flow in fluids, heat transfer to fluids without phase change, heat transfer to fluids with phase change, heat exchange equipment.
Unit 3	**Evaporation**
	Liquid characteristics, types of evaporators, principle and operation of single and multiple effect evaporators.
Unit 4	**Distillation**
	Vapor- liquid equilibrium, equipment setup, Flash Distillation, Batch Distillation, Continuous Distillation, operational features, construction and working only.
Unit 5	**Drying**
	Principle of drying, classification of dryers, temperature patterns in dryers, types of drying equipments, selection of drying equipment.
Unit 6	**Filtration**
	Mechanism of filtration, types of filters.
Unit 7	**Crystallization**
	Types of crystallizers, principle and operation.
Unit 8	**Size reduction**
	Different crushers and grinders, working principle.
Unit 9	**Leaching and extraction**
	Principle, working of equipments.
Unit 10	**Gas absorption**
	Principle and working operation of packed tower.
Unit 11	**Humidification and dehumidification**
	Equipment setup, principle of working.
Unit 12	**Adsorption**
	Principle and operation of equipment.
Unit 13	**Mixing**
	Types of mixers, construction and working.

Unit 14	**Introduction to process industries**
	Study of manufacturing process of cement plant, paper and pulp industries, petrochemical refinery industries, fertilizer industries, iron and steel industries, pharmaceutical industries, sugar industries etc. only study of flow diagram.
Reference Books:	
1.	M. G. Rao and Misting, "Outline of Chemical Technology", Second Edition, East west, 1973.
2.	McCabe, W.L., Smith, J. C., and Harriot, P., "Unit Operations in Chemical Engineering", McGraw- Hill Seventh Edition, 2004.
3.	Perry, "Chemical Engineer's Handbook", McGraw Hill, 1984.
4.	Stoker, "Designing of Thermal System", Third Edition.
5.	Leverspel O., "Chemical Reaction Engineering", Second Edition Willey Eastern Pvt Ltd.
Course outcomes:	
1.	To know the basic operation of a simple heat transfer, evaporator, distillation column, dryers, heat exchanger and refrigeration plant.
2.	To understand the theoretical concepts and principles used in unit operations and process and correlate them with various practical applications in instrumentation industries etc.
3.	To apply knowledge & understanding of various Unit Operations used in industry.
4.	To analyze the use of interlocks and trips as associated with these units.
5.	To justify the selection of proper instrument used for development of desired product by knowing construction, working, application, merits and demerits of various instruments.
6.	To design control strategies for process equipments.
Term Work:	
Eligibility for attending examination on this course is as follows	
1.	Students should submit minimum 5 assignments out of 8 assignments given by course coordinator.
2.	Students must submit a report on any one industrial visit.

Semester-VI

IN307 Process Control			
Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	4		

Course objectives:	
1.	To teach the fundamental aspects of process control, essential knowledge of process dynamics, developing dynamic models of processes, control strategies for linear time-invariant systems and instrumentation aspects, and controller tuning in order to assure required performance of the systems.
2.	To impart knowledgeable in the design of control systems and controller tuning for chemical processes.
Syllabus:	
Unit 1	**Introduction to chemical process control**
	Incentives for chemical process control, design aspects and hardware for a process control system, introduction to ISA symbology: P & ID for process control.
Unit 2	**Modeling of chemical processes**
	Development of a mathematical model, necessity, state variables and state equations, additional equations, additional elements of the mathematical models; dead time; modeling difficulties; the input-output model; degrees of freedom and process controllers; transfer function of a process with single/multiple outputs.
Unit 3	**Dynamic behavior of systems**
	Dynamic behavior of first order, second order and higher order systems; dynamic systems with dead time/inverse response, computer simulation of process dynamics, linearization of nonlinear systems.
Unit 4	**Controller modes**
	Controller principles, process characteristics, control system parameters, discontinues controller modes, two-position, multi position, floating control mode, continues controller mode, P, I and D, composite control mode, P+I, P+D, P+I+D controller modes.
Unit 5	**Dynamic behavior of feedback controlled processes**
	Input output models of feedback controllers, common measuring devices, transmission lines, final control element effect of on-off, proportional, integral, derivative and composite control actions on the response of a controlled process. Generation of control action: control action generation in electronic and pneumatic controllers.
Unit 6	**Design of feedback controllers**
	Outline of design problems; simple performance criteria, time integral performance content; selection of a feedback controller; controller tuning using Cohen-Coon method; Bode Stability criterion, gain and phase margins, Ziegler-Nichols tuning technique.
Unit 7	**Analysis and design of advanced control systems**
	Feedback control systems with large dead time or inverse response; cascade,

	selective and split range control; feed forward and ratio control; adaptive and inferential control systems.
Unit 8	**Design of control systems for multi variable processes**
	Synthesis of alternative control, configurations for multiple input-multiple output processes, interaction and decoupling of control loops; design of control systems for complete plants, some case studies.
Reference Books:	
1.	T. E. Marlin, "Process Control: Designing Processes and Control Systems for Dynamic Performance", McGraw Hill International Edition, 2000.
2.	G. Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", Prentice Hall of India, New Delhi, 2001.
3.	Luyben W. L., "Simulation and Control for Chemical Engineering", Second Edition Mc Graw Hill 1989.
4.	Curtis D. Johnson, "Process Instrumentation Technology", Fourth Edition, Prentice Hall of India, New Delhi, 1996.
5.	E. Umez- Eronini, "System Dynamics and Control", Thomason Learning, 2002.
Course outcomes:	
1.	To develop fundamental and empirical models for dynamic processes and apply control systems in processes.
2.	To get a complete overview of strategies for process control.
3.	To analyze and design advance control systems viz. cascade, selective and split range control; feed forward and ratio control; adaptive and inferential control systems.
4.	To design and tune process (PID) controllers.
5.	To gain familiarity with computer applications in process industries.
6.	To set up career options, potential job functions, contemporary and professional issues.
Term Work:	
The term work shall consist of a record of at least eight experiments based on the syllabus given above. Some of the experiments may be from the following list.	
1.	Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller.
2.	Design an electronic PID controller and study its response for step input.
3.	Design electronic temperature transmitter for transmitting temperature from 500°C to 900°C to 4 to 20mA.
4.	**Cascade control trainer (P, PI, PID, On / off)** Study of Cascade Control trainer (Flow & Level control)
5.	**Level control trainer** a) Study of open loop response (Manual control) b) Study of on/off controller c) Study of proportional controller d) Study of proportional integral controller e) Study of proportional derivative controller f) Study of proportional integral derivative controller g) Tuning of controller (Open loop method) h) Tuning of controller (Closed loop method)
6.	**Flow control trainer** a) Study of open loop response (Manual control)

	b) Study of on/off controller c) Study of proportional controller d) Study of proportional integral controller e) Study of proportional derivative controller f) Study of proportional integral derivative controller g) Tuning of controller (Open loop method) h) Tuning of controller (Closed loop method)
7.	**Flow measurement** a) To Calculate coefficient of discharge of Venturi meter. b) To Calculate coefficient of discharge of Orifice meter. c) To Calculate coefficient of discharge of Pitot tube. d) To calibrate and find accuracy of Rotameter. e) To find accuracy of Water meter.
8.	Determine the time-constant of RTD for given step-input.
9.	To determine the mathematical model of the given process.
10.	To determine the constants of PID controllers by given method.
11.	Use of dead beat algorithm and other algorithms in the controller design.
12.	Use of optimum controller methods for tuning of PID controller.

IN308 Control System Components

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	4		

Course Objectives:

1.	To enable the students to understand the fundamentals of various types of components being used in control systems.
2.	To identify, select and design a suitable devices and components for use in process industries.

Syllabus:

Unit 1	**Motors**
	Types, working principle, characteristic, and mathematical model of following: motors AC/DC motors, stepper, servo, synchronous generators and alternator.
Unit 2	**Types, working principle, characteristics, and symbolic representation of following**
	Switches: toggle, slide, DIP, rotary, thumbwheel, selector, limit, proximity, combinational switches, zero speed, belt sway, pull cord, Relays: Electromechanical, Solid state relays, relay packages, Contactors :Comparison between relay and contactor, contactor size and ratings, Timers : On delay, off delay and retentive.
Unit 3	**Sequencing and interlocking for motors**
	Concept of sequencing and Interlocking, Standard symbols used for Electrical Wiring Diagram, electrical wiring diagrams for starting, stopping, emergency shutdown, (Direct on line, star delta, soft starter) protection devices for motors: short circuit protection, over load protection, over/ under voltage protection, phase reversal Protection, high temperature and high current Protection, over

	speed, Reversing direction of rotation, braking, starting with variable speeds, Jogging/Inching. Motor control center: concept and wiring diagrams.
Unit 4	**Pneumatic components**
	Pneumatic power supply and its components: Pneumatic relay (Bleed and Non bleed, Reverse and direct), single acting and double acting cylinder, special cylinders: cushion, double rod, tandem, multiple position, rotary Filter Regulator Lubricator (FRL), pneumatic valves (direction controlled valves, flow control etc), special types of valves like relief valve, pressure reducing etc.
Unit 5	**Hydraulic components**
	Hydraulic supply, hydraulic pumps, actuator (cylinder and motor), hydraulic valves. Introduction, basic types of hydraulic transmission lines, servo motors, power supply, hydraulic circuits and transmission, applications like motor speed control, reciprocating, loading, unloading, sequencing of cylinders and direction control. Symbols used in hydraulic circuits.
Unit 6	**Control valves**
	Valve terminologies, classification of valves. Valve actuators and accessories, detail study of valve characteristics. Study of valve construction by considering examples from hydraulic, pneumatic and electrical types. Introduction to valve selection and specifications. Selection of characteristics to suit the process, for gas, vapor and liquid. Valve sizing with mathematical treatment. Cavitations, effects and remedies of cavitations. Introduction to analog and digital fluidic devices.
Text Books:	
1.	M. D. Desai, "Control system components", PHI.
2.	S. R. Majumdhar, "Pneumatic Systems", Tata McGraw-Hill Publisher, 2009.
3.	B. L. Theraja, "A text book of Electrical Technology", S. Chand & Company Ltd., Vol II First Edition 1959.
Reference Books:	
1.	Douglas M. Considine, "Process Instruments and Control Handbook", McGraw Hill.
2.	H. Meixner, E. Sauer, "Intro to Electro-Pneumatics", Festo didactic, First Edition 1989.
3.	J. P. Hasebrink, R. Kobler, "Fundamentals of Pneumatic Control Engineering", Festo Didactic: Esslinger(W Germany),1989.
4.	Petruzella, "Industrial Electronics", McGraw-Hill International First Edition, 1996.
5.	E. A . Parr, "Industrial control Handbook",volume 2, BSP Professional Books.
6.	Ernest O. Doebelin, "Measurement Systems – Application and Design", Fourth Edition, McGraw Hill.
7.	I. J. Nagrath, M. Gopal, "Control system Engineering", New Age International Publication Fourth Edition, 2006.(W.E)
8.	B. G. Liptak, "Process Measurement and Analysis", Fourth Edition, CRC Press, Washington, 2003.
9.	John E. Gibson (Purdue) and Franz B. Tuteur (Yale), "Control System Components", McGraw-Hill, New York, 1958.
10.	Hans D. Baumann, "Control valve primer", ISA; Fourth Revised Edition (15 November 2008).
11.	Les Driskell, "Control – Valves Selection and Sizing", ISA 1983.

12.	W. G. Andrew and H. B. Williams, "Applied Instrumentation in the Process Industries", Gulf Publishing Company, 1982.
13.	C. D. Johnson, "Process Control Instrumentation Technology", Fourth Edition, Prentice.
Course outcomes:	
1.	To know the mechanical, hydraulic, pneumatic and electrical components of control the systems.
2.	To understand control valve construction, valve terminologies, valve actuators/accessories and valve characteristics.
3.	To apply the knowledge of mathematical modeling to prepare transfer function of AC & DC motors.
4.	To classify various kinds of electrical motors and outline their applications in the field of control systems.
5.	To explain importance of different types of relays in control applications.
6.	To design and construct the mathematical model of control system components and execute the instrumentation requirements in process industries.
Term Work:	
It will consist of at least eight experiments/assignments/programs from the following list:	
1.	Study of cut section views of different control system components.
2.	Study of stepper motor.
3.	Study of AC/ DC servo motors.
4.	Study of motor speed torque characteristics.
5.	Study of hydraulic control valves and accessories.
6.	Study of pneumatic control valves and accessories.
7.	Study of ON/OFF, linear and equal percentage valve characteristics.
8.	Study of logic fluidic devices.
9.	Study of flapper nozzle system.
10.	Study of different types of relays.

IN309 Distributed Control System

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	1	hrs/week	
Practical	2	hrs/week	
Credits	5		

Course objectives:	
1.	This course is designed to expose students to understand the process automation concepts like programmable logic controller and distributed control system.
Syllabus:	
Unit 1	**Programmable Logic Controllers (PLC)**
	Introduction, architecture, definition of discrete-state process control, discrete – state variables, process specifications, event sequence description.
Unit 2	**Industrial PLC- Allen Bradely**
	Studies of Allen Bradely make Micrologix1200c and 1100 PLC.
Unit 3	**Ladder diagram**

	Background, ladder diagram elements, ladder diagram examples, programmable controllers: relay sequencer, programmable controllers, programmable controller operation, programming, advanced features, ladder diagrams and programming for some typical examples of process control using ABB PLC.
Unit 4	**Study of ABB, GE Fanuc and Siemens make PLC**
	Introduction, programming.
Unit 5	**Supervisory Control And Data Acquisition(SCADA)**
	Introduction to supervisory control and data acquisition (SCADA) as applied to process control systems: Introduction to various SCADA packages, study of RSVIEW32 (AB make package) development of mimics using RSVIEW32 SCADA package, Study of iFix SCADA package, WinCC.
Unit 6	**Distributed Control Systems (DCS)**
	Introduction, difference between DCS and centralized computing system. Block diagram of DCS, data highways, multiplexers and remote sensing terminal units Study of various aspects of DCS like communication protocol, displays, cables etc., various system architectures of DCS.
Unit 7	**Yokogawa Centum VP**
	Architecture, study of FCS, programming using FBD, typical examples based on FBD programming, development of HMI's, process applications of Centum VP.
Unit 8	**Other DCS systems**
	Study of EPKS Honeywell DCS, Emerson's Delta V DCS, hardware and software basics of these DCS systems, introduction to Hybrid DCS.
Unit 9	**Network protocols**
	Introduction, study of various protocols like HART, Device net, Control net, Ethernet, Modbus, Profibus, Field Bus: Introduction, study of foundation field bus.
Unit 10	**Design consideration**
	Design of PLC/DCS system, design of marshalling cabinet, power consumption calculation, power distribution diagrams, functional design specification.
Reference Books:	
1.	Gary Dunning, "Introduction to Programmable Logic Controllers" Second Edition, Thomson Delmar learning, 2002.
2.	C. D. Johnson, "Process Control Instrumentation Technology" Seventh Edition, Pearson Education, New Delhi 2003.
3.	B. G. Liptak, "Instrument Engineers Handbook" (Edition) Vol-II and III, Chilton book Company.
4.	Technical Manual –Yokogoawa, centum VP.
5.	Webb J. W. and Ronald A. Reis "Programmable Controllers: Principles and Applications", Prentice Hall of India Pvt. Ltd. Fifth Edition, 2005.
6.	John R. Hackworth and Frederick D. Hackworth "Programmable Logic Controllers", Jr. Third India Reprint 2005.
7.	Parr A., Newnes, "Programmable Controllers: An Engineer's Guide", Butterwoth-Heinmen Ltd. 1993.
8.	C. D. Johnson, "Microprocessor based Process Control", Prentice Hall International Edition.
9.	Manual of Hybrid DCS-AB Control Logix.

Course outcomes:	
1.	To describe the basics of PLC and Ladder diagram programming language.
2.	To explain the basics of SCADA and different SCADA/HMI software available.
3.	To apply the knowledge of basics of ladder diagram to solve various instrumentation problems.
4.	To design SCADA PLC based systems for process control application.
5.	To explain the basics of Distributed Control System architecture and programming.
6.	To analyze various programming languages used in industrial automation systems.
Term Work:	
Term work shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list.	
1.	Study of AB Micrologix 1200c and 1100 PLC.
2.	Development of simple ladder diagrams like AND/OR gate.
3.	Developments of ladder diagram for the controlling motor operation.
4.	Development of ladder diagram and simulation for the level control system.
5.	Development of ladder diagram for bottling plant.
6.	Study of software package RSVIEW32 (AB make) for SCADA.
7.	Development of mimic diagram for a particular process using SCADA software.
8.	Study of Hybrid controller control logix (AB MAKE).
9.	Development of programs for control of processes using Hybrid controller.
10.	Study of Yokogowa Centum VP.
11.	Development of FBD programs on Centum VP for ON/OFF control.
12.	Development of FBD programs on Centum VP for simple process control applications.

IN310 Power Electronics

Teaching scheme:			Examination scheme:
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	4		

Course objectives:	
1.	To introduce to students the theoretical concepts and applications of power electronics systems for high efficiency, renewable and energy saving conversion systems.
2.	To prepare students to know the characteristics of different power electronics switches, drivers and selection of components for different applications.
3.	To prepare students to have good understanding of the basic principles of switch mode power conversion.
4.	To know the operating principles of application of power electronic circuits as motor drives, UPS systems, etc.
Syllabus:	
Unit 1	**Introduction**
	Modern power semiconductor devices and their characteristics, gate drive specifications, ratings, applications, turn ON and turn OFF methods, design of

	gate triggering circuits using UJT and thyristor protection circuits.
Unit 2	**Phase controlled rectifiers**
	Single phase rectifiers: Half wave, center tapped, bridge (half controlled and fully controlled) with R and RL load. Three phase rectifiers: half wave, bridge with R and RL load effect of source inductance, dual converters, power factor improvement methods.
Unit 3	**DC chopper**
	Basic chopper, continuous and discontinuous current conduction, TRC, CLC methods, classification of choppers, step-up chopper, switching mode regulators.
Unit 4	**AC voltage controller & cycloconverters**
	AC voltage controller: types of ac voltage controllers, single-phase and three phase ac voltage controllers with R and RL load, transformer tap changers, single phase to single phase cycloconverters, three phase to single phase cycloconverters, three phase to three phase cycloconverterswith circulating and non-circulating mode.
Unit 5	**Inverters**
	Single phase inverters: series, parallel and bridge configurations with R load, PWM inverters. Three phase inverters: 120° and 180° conduction with R and load RL, voltage control and harmonics reduction.
Unit 6	**Application in power electronics**
	UPS and SMPS, basic characteristics of DC motors, operating modes, DC motor control using different rectifiers, induction motor drives, performance characteristics, stator voltage control, rotor voltage control, frequency control, voltage and frequency control.
Reference Books:	
1.	V. R. Moorthi, Power Electronics: Devices, Circuits and Industrial Applications, Oxford University Press, 2006.
2.	M. H. Rashid, Power Electronics: Circuits, Devices, and Applications, Pearson Education, Inc. Third Edition, 2004.
3.	M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Limited, New Delhi (India), 1998.
4.	P. S. Bimbhra, Power Electronics, Khanna Publishers, New Delhi (India), Second Edition, 1998.
5.	G. De, Principles of Thyristorised Converters, Oxford and IBH Publications.
Course outcomes:	
1.	To understand the basic principle, characteristics and applications of power electronic and switching devices.
2.	To extend simple power electronic converters to realize rectifiers and inverters.
3.	To develop and quantify common performance objectives for power electronic circuits such as efficiency, power factor, etc.
4.	To analyze and design DC/DC converter (chopper) circuits.
5.	To analyze and evaluate the operation of cycloconverters and voltage controllers.
6.	To outline operating principles of application of power electronic circuits as motor drives, UPS systems, etc.
Term Work:	

It will consist of a record of at least six to eight experiments based on the following list..	
1.	UJT Relaxation oscillator.
2.	SCR characteristics.
3.	Triac characteristics.
4.	Power control using SCR.
5.	Power control using Triac.
6.	Single phase controlled Rectifiers.
7.	Single phase half controlled Rectifiers.
8.	Single phase fully controlled Rectifiers.
9.	Single phase inverter using transistor/ MOSFET/IGBT.
10.	Basic step-down chopper.
11.	Basic step-up chopper.
12.	Study of D.C. motor control using controlled rectifiers.
13.	Study of D.C. motor control using choppers.
14.	Study of A.C. motor control using inverter.
Practical Examination:	
The examination will be of three hours duration, and will consist of an experiment based on Term-work and followed by an oral based on above syllabus.	

IN311 Power Plant Instrumentation

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course Objectives:	
1.	To provide a window of applications of instrumentation and automation in power plants.
2.	Additionally students know about the various methods of power generation and its control methods in instrumentation engineering.
Syllabus:	
Unit 1	**Introduction**
	Various types of power plants based on the methods of power generation example-thermal, nuclear, solar, wind power, geothermal, magneto hydraulic etc., MHD, GT, thermo dynamics and cycle of power generation.
Unit 2	**Thermal power plant**
	Building blocks - ideal steam cycles – boiler – types, boiler - turbine units and its range systems, feed water systems, steam circuits, combustion process, products of combustion process, fuel systems, treatment of flue gases, steam turbine, condensate systems, alternator, feed water conditioning, turbine bypass valves. Importance of instrumentation in power generation – details of boiler processes. Various types of power plant and their configuration and comparison.
Unit 3	**Measurement in boiler and turbine**
	Metal temperature measurement in boilers, piping system for pressure measuring devices, smoke and dust monitor, flame monitoring. Introduction to turbine supervising system, pedestal vibration, shaft vibration, eccentricity

	measurement. Installation of non-contacting transducers for speed measurement, rotor and casing movement and expansion measurement.
Unit 4	**Controls in boiler**
	Problems associated with control of multiple pulverizers. draught plant: introduction, natural draught, forced draught, induced draught, power requirements for draught systems. Fan drives and control, control of air flow. combustion control: fuel/air ratio, oxygen, CO and CO2 trimming, combustion efficiency, excess air, parallel and cross limited combustion control, control of large systems.
Unit 5	**Controls in boiler**
	Boiler drum level measurement methods, feed water control, soot-blowing operation, steam temperature control, coordinated control, boiler following mode operation, turbine following mode operation, sliding pressure mode operation, selection between boiler and turbine following modes. Soot blowers, distributed control system in power plants-interlocks in boiler operation. Turbine control: pressure control – lubricant oil temperature control – cooling system, governor control, turbo-supervisory instrumentation (TSI).
Unit 6	**Alternator instrumentation and control**
	Generator cooling system, hydrogen charging and discharging system.
Unit 7	**Auxiliaries in power plants**
	Electrostatic precipitator, fuel oil handling system, water treatment plant, cooling towers, ash handling and coal handling.
Unit 8	**Steam turbine control systems**
	Instrumentation and control of condenser, steam heaters, pumps and compressors.
Unit 9	**Hydroelectric power plant**
	Site selection, classification of hydropower plants, types of turbines for hydroelectric power plant, hydrology estimation electric power to be developed, pumped storage plants, storage reservoir plants, instrumentation used in hydroelectric power plant.
Unit 10	**Nuclear power plant instrumentation**
	Piping and instrumentation diagram of different types of nuclear power plant, nuclear reactor control loops, reactor dynamics, excess reactivity, pulse channel and logarithmic instrumentation, control and safety instrumentation, reliability aspects.
Unit 11	**Non-conventional energy sources and power distribution schemes**
	Wind power, solar power, tidal power, diesel generator controls, combined operation of different power plants.
Text Books:	
1.	National Power Training Institute Manuals.
2.	P.C Martin, I. W Hannah, “Modern Power Station Practice”, British Electricity International Vol. 1 & VI, Pergamon Press, London, 1992.
3.	Arora and Domkundwar “A Course in Power Plant Engineering”, Dhanpat Rai and Sons, New Delhi.
4.	Keswani H. B., “Power Plant Engineering”, Standard Book House Delhi.
Reference Books:	
1.	Sam. G. Dukelow, “The Control of Boilers”, Second Edition, ISA Press, New York, 1991.

2.	P. K. Nag, "Power Plant Engineering", Third Edition, 2010. McGraw Hill.
3.	K. Krishnaswamy, M. PonniBala, "Power Plant Instrumentation", PHI Learning Pvt. Ltd., 2011.
4.	Black & Veatch, "Power Plant Engineering", Springer, 1996.
5.	David Lindsley, "Boiler Control Systems", McGraw Hill, New York, 1991.
6.	M. W. Jervis, "Power station Instrumentation", Buuterworth-Heinemann Publication, 2000.
7.	B. G. Liptak, "Instrumentation Engineers Handbook: Process Measurement", Chilton Book Company.
Course outcomes:	
1.	To remember the innovative ideas to improve plant efficiency reduce leakages and losses and use technologies for designing and developing pollutant free industrial environment.
2.	To understand the operation of traditional power plants and describe the instruments that makes up their measurement and control systems.
3.	To apply the knowledge of mathematics for deriving mathematical models for different processes in the power plant.
4.	To analyze the various instruments used in power plant and make recommendations for improving the control processes.
5.	To evaluate the performance of boilers and turbines.
6.	To design instrumentation systems for electricity generating plants.
Term Work:	
Eligibility for attending examination on this course is as follows:	
1.	Student should submit minimum 5 assignments out of 8 assignments given by course coordinator.
2.	Students must submit a report on any one industrial visit.

IN312(I) Elective-II Digital System Design

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:	
1.	To understand the constructs and conventions of the Verilog / VHDL programming.
2.	To design and modeling of combinational, sequential digital systems and Finite State Machines.
Syllabus:	
Unit 1	**VLSI design flow**
	Design entry-Schematic, Introduction to Verilog HDL/VHDL, synthesis; simulation, overview of different modeling styles in HDL, data types and objects, dataflow, behavioral and structural modeling, HDL constructs: packages, library, configuration, delays, functions, procedures, attributes.
Unit 2	**Combinational and Sequential Logic Design**
	Adders subtractors, ALU, decoder, encoder, multiplier, comparator, Barrel shifters, multiplier design and its VHDL implementation multi-operand

	addition, sequential multiplication with sign and magnitude, two's complement, partially combinational implementation, MAC, saturating multiplier, truncating multiplier, rectangular multiplier.
Unit 3	**Programmable Logic Devices**
	Combinational logic design using PLDs like ROM array, PLA, PAL, preliminary design concepts using CPLDs and FPGAs.
Unit 4	**Synchronous sequential circuits**
	Design of counters and sequential networks, analysis of clocked sequential networks, Finite State Machine Models(FSM)-Moore machine and Mealy machines- serial binary adder, sequence detector, FSM design- state table reduction, state assignment, general models of sequential machines, state equivalence and machine minimization.
Unit 5	**Data path design**
	Designing dedicated data path, general datapath design, timing issue, VHDL implementation of datapath.
Unit 6	**Control unit design**
	Constructing the control unit, stand alone controllers, ASM charts and state action tables, VHDL implementation of control unit. Examples of manual design of dedicated microprocessors.
Text Books:	
1.	R.P. Jain, "Modern digital Electronics", Tata McGraw Hill.
2.	Douglas Perry, "VHDL", Tata McGraw Hill.
3.	J. Bhasker, VHDL Primer, Pearson Education Asia, Third Edition.
Reference Books:	
1.	Gothman," Digital Electronics-An introduction to theory and practice", Pearson Education.
2.	Morris Mano, "Digital Design", Second Edition, Prentice Hall of India Publication, New Delhi.
3.	J. F. Wakerly, "Digital design- Principles and Practices", PH International/Pearson India, Third Edition.
4.	Frank Vahid, "Digital Design", Preview Edition, John Wiley & Sons Inc., 2005.
5.	Charles Roth," Digital System Design using VHDL", Tata McGraw Hill.
6.	Stephan Brown, Zvonko Vranesic,"Fundamentals of Digital Logic with VHDL Design", McGraw Hill, Second Edition, 2005.
Course outcomes:	
1.	To remember the basic knowledge of combinational and sequential logic design.
2.	To understand advanced features of verilog HDL and apply them to design complex real time digital systems.
3.	To execute program codes for structural and behavioral modeling of combinational and sequential logic using Verilog HDL in any problem identification, formulation and solution.
4.	To examine various abstraction levels of Verilog HDL in modeling digital hardware.
5.	To evaluate and design the modeling of combinational, sequential digital systems and Finite State Machines.
6.	To design and apply the concept of test-benches to create testing behavioral environments for simulation based verification.

IN312(II)Elective-II Optical Instrumentation

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course Objectives:	
1.	To understand the working of optical fiber as a sensor.
2.	To apply and usage of optical fiber to measure various physical parameters.
3.	To study and identify applications of LASER in instrumentation & measurement.

Syllabus:	
Unit 1	**Introduction**
	Light and elements of solid state physics nature of light, wave nature of light, light sources black body radiation, units of light Energy bands in solids, semiconductor types, works function, functions.
Unit 2	**Display devices**
	Luminescence, insertion luminescence and the light emitting diode, radiative recombination processes LED materials, commercial LED materials LED construction, response time of LEDs, LED drive circuitry plasma display liquid crystal displays.
Unit 3	**Lasers**
	Emission population inversion, optical feedback classes of laser, doped insulator lasers semiconductor lasers, gas lasers, liquid dye lasers, laser applications, measurement of distance holography.
Unit 4	**Photodetectors**
	Thermal detectors: thermoelectric detectors, the bolometer, pneumatic detector, pyroelectric detector photo devices photoemissive devices vacuum photo diodes photo multipliers, noise in photo multipliers, image intensifier photo conductive detection photo transistor etc.
Unit 5	**Optical fibers**
	Classification of optical fiber, principle of light transmission through a fiber, fabrication of optical fibers, material consideration loss and band width limiting mechanism, preform fabrication technique, fiber drawing, fiber optic communication system introduction to fiber optic sensors: temperature pressure, level etc.
Unit 6	**Opto electronic power devices**
	Solar cells and their application.
Unit 7	**Opto isolators**
	Different types and their configuration applications.
Unit 8	**Optical instruments**
	Calorimeter, spectrophotometer, flame photometer fluorimeter and turbidity meter.

Reference Books:	
1.	Pallab Bhattacharya, “Semiconductor Optoelctronic Devices”, Second Edtion, Pearson Education, New Delhi, 2002.

2.	J. Wilson J.F.B.Hawkes, "Opto Electronics – An Introduction", Prentice Hall of India New Delhi, 1996.
3.	Deboo Burrous, "Integrated circuits and semiconductor devices: theory and application", McGraw Hill Second Edition.
4.	J. M. Senior, "Optical fiber communications Principals and Practice", Prentice Hall of India, Second Edition, 1996.
5.	H. Zanger and C. Zanger, "Fiber optics – communication and other application", McGraw Publication.
6.	Gerd Keiser, "Optical Fiber Communication".
Course outcomes:	
1.	To know the basic concepts of optical fibers and to provide knowledge about optical sources and optical detectors.
2.	To classify the optical sources and detectors and to discuss their principle and understand the industrial applications of optical fibers.
3.	To apply LASER and optical fiber for various physical parameter measurements.
4.	To analyze the optical sensor technology on various parameters of measurements.
5.	To explain the basic elements of optical fiber transmission link, fiber modes configurations and structures.
6.	To familiar with design considerations of fiber optic systems.

IN312(III) Automotive Instrumentation

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:	
1.	To understand the concepts of automotive electronics and its evolution and trends.
2.	To understand, design and model various automotive control systems using Model based development technique.
3.	To describe various communication systems, wired and wireless protocols used in vehicle networking.
4.	To understand safety standards, advances in towards autonomous vehicles.
5.	To understand vehicle on board and off board diagnostics.
Syllabus:	
Unit 1	**Introduction of automobile system**
	Current trends in automobiles with emphasis on increasing role of electronics and software, overview of generic automotive control ECU functioning, overview of typical automotive subsystems and components, AUTOSAR.
Unit 2	**Engine management systems**
	Basic sensor arrangement, types of sensors such as oxygen sensors, crank angle position sensors, fuel metering/ vehicle speed sensors, flow sensor, temperature, air mass flow sensors, throttle position sensor, solenoids etc., algorithms for engine control including open loop and closed loop control system, electronic ignition, EGR for exhaust emission control.

Unit 3	**Vehicle power train and motion control**
	Electronic transmission control, adaptive power steering, adaptive cruise control, safety and comfort systems, anti-lock braking, traction control and electronic stability, active suspension control.
Unit 4	**Active and passive safety system**
	Body electronics including lighting control, remote keyless entry, immobilizers etc., electronic instrument clusters and dashboard electronics, aspects of hardware design for automotive including electro-magnetic interference suppression, electromagnetic compatibility etc., (ABS) antilock braking system, (ESP) electronic stability program, air bags.
Unit 5	**Automotive standards and protocols**
	Automotive standards like CAN protocol, Lin protocol, flex ray, OBD-II, CAN FD, automotive Ethernet etc. automotive standards like MISRA, functional safety standards (ISO 26262).
Unit 6	**System design and energy management**
	BMS (battery management system), FCM (fuel control module), principles of system design, assembly process of automotives and instrumentation systems.
Text Books:	
1.	William B. Ribbens, "Understanding Automotive Electronics", Sixth Edition, 2003.
Reference Books:	
1.	Young A.P., Griffiths, "Automotive Electrical Equipment", ELBS & New Press, 1999.
2.	Tom Weather Jr. & Cland c. Ilunter, "Automotive computers and control system", Prentice Hall Inc., New Jersey.
3.	Crouse W.H., "Automobile Electrical Equipment", McGraw Hill Co. Inc., New York, 1995.
4.	Bechhold,"Understanding Automotive Electronic", SAE, 1998.
5.	Robert Boshe, "Automotive Hand Book", Bentely Publishers, Fifth Edition, Germany, 2005.
Course outcomes:	
1.	To acquire knowledge of various automotive standards and Protocols.
2.	To understand the basic knowledge of sensor and measuring system.
3.	Ability to understand electronic control unit.
4.	To analyze and understand the overview of automotive components, subsystems, design cycles, communication protocols and safety systems employed in today's automotive industry
5.	To select the basic modeling and control scheme for automotive systems.
6.	Design aspects of measurement and control strategies in automotive application.

IN312(IV) Mechatronics

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:	
1.	The aim of the module is to introduce the basic elements of mechatronics and illustrate with case study material.
Syllabus:	
Unit 1	**Introduction**
	Meachatronics, measurement system, overview of mechatronics, mechatronics design approach, system interfacing, instrumentation and control systems, microprocessor-based controllers.
Unit 2	**Sensors, signal conditioning and actuators**
	Various transducers used for measurement of displacement, position, velocity, force, pressure, temperature, signal conditioning, data presentation and data logging system, introduction to various actuators, comparison of various actuators, selection of actuators.
Unit 3	**Process switches**
	Temperature switches, pressure switches, flow switches, level switches, electrically operated switches, magnetic switches, solid state switches and solenoids.
Unit 4	**Systems models review**
	Mathematical models, mechanical system building blocks, electrical system building blocks, fluid system building blocks, thermal system building blocks, rotational translational systems, electromechanical systems, hydraulic mechanical systems, system transfer function, dynamic response of systems, frequency response.
Unit 5	**Study of advance process control blocks**
	Statistical process control, model predictive control, fuzzy logic based control, neural-network based control. Higher level operations: control & instrumentation for process optimization, applications of the above techniques to the some standard units/processes.
Unit 6	**Fault finding**
	Fault detection techniques, watchdog timer, parity and error coding checks, common hardware faults, microprocessor systems, emulation and simulation, PLC systems.
Unit 7	**Robotics**
	Introduction to robots, classification of robots, and anatomy of robots, degree of freedom, robot joints and robot coordinates various applications of robots.
Unit 8	**Mechatronics systems**
	Case study-1: Design of electrically controlled robot arm for sorting application Cast Study-2: Design of a robotic walking machine Case study-3: Design of control scheme for automatic bottle filling plant Case study-4: Design of control scheme for automatic baggage handling system. Case study-5: Design of control scheme home automation
Text Books:	
1.	Mittal R. K. and Nagrath I. J. , “Robotics and Control”, TMH Pub., New Delhi, 2003.
2.	M. D. Singh, J. G. Joshi, Mechatronics, PHI.

Reference Books:	
1.	W. Bolton, "Mechatronis: Electronic Control Systems in mechanical and electrical engineering", Third Edition, Pearson education (Singapore) Ltd., 2005.
2.	Tsunco Yoshikawa, "Foundations of Robotics, Analysis and Control", prentice Hall of India, 2001.
3.	David Alciatore and Histand, "Introduction to Mechatronics and measurment system", TMH.
4.	Dan Necsulescu, "Mechatronics", Pearson Education, Asia.
5.	Robert H. Bishop, "The Mechatronics Handbook", CRC Press, with ISA–The Instrumentation, Systems, Automation Society, 2002.
6.	B.G. Liptak 'Handbook of Instrumentation- Process Control'.
7.	Atkeson C. G. & Hollerbach J. M., "Model based control of a Robot manipulator", MIT Press, Mass., 1988.
Course outcomes:	
1.	To recalling the basic techniques, skills and modern tools in mechatronics engineering technology.
2.	To understand customer requirements and effectively integrate multiple mechanical and electrical systems.
3.	To apply concepts of circuit analysis, analog and digital electronics, automation and controls, motors, power systems, instrumentation and computers to aid in the design, characterization, analysis and troubleshooting of mechatronics systems.
4.	To analyze advanced principles of statics, dynamics, fluid mechanics, and strength of materials, engineering standards and manufacturing processes to aid in the design.
5.	To calculate the interfacing parameters required to connect digital and analogue sensors to computers.
6.	To design a system component or process to meet desired needs within realistic constraints, such as economic, environmental and/or social.

IN312(V) Material Science

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:	
1.	To know the fundamental science and engineering principles relevant to materials.
2.	To understand the relationship between nano /microstructure, characterization, properties and processing and design of materials.
3.	To develop an understanding of the basic principles of material science and apply those principles to engineering applications.
Syllabus:	
Unit 1	**Introduction to engineering materials**
	Materials classification and engineering requirements of materials, factor affecting the selection of materials for engineering purposes, properties of

	engineering materials , testing of materials, tensile test, torsion and shear test, compression test, impact test, hardness test, fatigue test, S-N diagram, creep of materials, Erichsen test.
Unit 2	**Materials and their applications**
	Electrical and electronic component, materials for resistors, properties and applications, superconducting materials, transducers materials, semiconductors-commonly used type working applications. thermistors, piezoelectric, ferro electric and ferro ceramic materials, die electric materials and dielectric constant, capacitor insulating materials, properties of fibrous material, ceramic, mica glass, rubber, plastics, thermosetting and thermoplastic resins, insulating waxes, varnishes and coolants. Effects of carbon composition and applications.
Unit 3	**Magnetic materials**
	Soft material and hard magnetic materials, ferrites and Di para antiferro, ferromagnetism.
Unit 4	**Thermocouple materials**
	Soldering materials, fuse materials, contact materials, fluorescent and phosphorescent materials, processing of electronic materials, crystal growth, purification junction, IC fabrication processes of galvanizing and impregnatism.
Unit 5	**Nanomaterials**
	Introduction to nanotechnology, Nanowire and Nanotube, carbon nanotubes, single wall carbon nanotubes, Multiwall carbon nanotubes, fabrications, properties and applications.
Unit 6	**Introduction to manufacturing processes**
	Casting, cold working and hard working processes like rolling, forging, extrusion etc., crystal structure of metals and alloys: FCC, BCC, HCP.
Text Books:	
1.	Alagappan W., Kumar N. T.,"Electrical Engineering Materials", McGraw Hill 1998.
2.	Agrawal B. K., "Engineering Material", Mc-Graw Hill Publishing company, 2000.
3.	Raghavan V., "Materials Science and Engineering – A first course", Fifth Edition, Prentice Hall, New Delhi, 1998.
4.	Dr. V. D. Kodgire, "Material science and Metallurgy", Everest Publishing House, Twelveth Edition 2002.
Reference Books:	
1.	Raymond A. Higgins, "Material for Engineering Technician", Second Edition, ELBS, 1998.
2.	R. M. Rose, L. A. Shepard, "The structure and Properties of Materials", Vol. IV, John Wulff, John Wiely and Son Inc.198.
3.	Smith W. F. and Hashemi J., "Foundations of Materials Science and Engineering", Fourth Edition, Mc Graw Hill, United States, 2005.
4.	VanVlack L. H., "Elements of material science and engineering," Pearson Education India.
Course outcomes:	
1.	To define electrical, magnetic and optical properties of materials.
2.	To identify, formulate, and solve engineering problems.
3.	To apply core concepts in Materials Science to solve engineering problems.

4.	To examine general math, science and engineering skills to the solution of engineering problems.
5.	To select suitable materials for specific instrumentation devices.
6.	To design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

IN312(VI) Elective-II Microelectronics

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course Objectives:

1.	To make the students familiar with the properties behaviour and applications and implementation of microelectronic technology into integrated circuits.
2.	A sound knowledge of the fundamental scientific principles involved in the operation, design and fabrication.
3.	An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
4.	Understand the basic and advanced circuit and system design techniques for digital and analog domain.

Syllabus:

Unit 1	**Technology of semiconductor devices**
	Materials, crystal growth, film formation, lithography, etching and doping. conductivity, charge densities, E-K relation, fermi level, continuity equation, Hall effect and its applications.
Unit 2	**pn junction and metal semiconductors**
	The pn junction and metal semiconductor contact, basic structure of pn junction, metal semiconductor contact, doped pn junction.
Unit 3	**Fundamentals**
	Fundamentals of MOSFET, MOSFET action, MOS capacitor, MOSFET operations, small signal equivalent circuit, MOSFET scaling, non-ideal effects, threshold voltage modifications, additional electrical characteristics, CMOS circuits, Bi-CMOS circuits, CCDs.
Unit 4	**Power devices, operation and characteristics**
	Thyristor family, power diodes, power transistors, GTOs and IGBTs. Display devices, operation of LCDs, LED, HDTV, plasma displays.

Text Books:

1.	Donald Neamen, “An introduction to semiconductor devices”, McGraw Hill International Edition, 2006.
2.	S. M. Sze, “Semiconductors Devices, Physics and Technology”, Second Edition, Wiley, 2002.
3.	A. S. Sedra & K. C. Smith, “Microelectronic Circuits” Sixth Edition, Oxford, 2010.
4.	B. G. Streetman, S. K. Banerjee, “Solid state Electronic devices”, Sixth Edition,

	PHI, 2010.
Reference Books:	
1.	J. Millman and C. C. Halkias, "Electronic devices and Circuits", McGraw Hill, 1976.
2.	Adir Bar-Lev, "Semiconductors and Electronic Devices", Third Edition, Prentice Hall,1993.
3.	L. Macdonald & A. C. Lowe, "Display Systems", Wiley, 2003.
Course outcomes:	
1.	To know the semiconductor concepts of drift, diffusion, donors and acceptors, majority and minority carriers, excess carriers, low level injection, minority carrier lifetime.
2.	To discuss the electronic analysis of CMOS logic gates, delay analysis, analysis of complex logic gates, power dissipation.
3.	To apply simple large signal circuit models for metaloxide-semiconductor (MOS) capacitors devices which include charge storage elements and analyze the secondary effects of MOSFET.
4.	To analyze the basic structures to create MOSFETs, cell concepts, physical design of logic gates, design hierarchies.
5.	To evaluate VLSI design flow and transistor level CMOS logic design, discuss the physical structure of IC layers to create MOSFETs.
6.	To design and verify schematic and layout simulation of analog and digital CMOS VLSI circuits.

IN312(VII) Elective-II Data Structure and Algorithms

Teaching scheme:			**Examination scheme:**
Lectures	3	hrs/week	Theory Mid Term : 30 marks, End Sem. Exam: 70 marks
Tutorials	0	hrs/week	
Practical	0	hrs/week	
Credits	3		

Course objectives:	
1.	To introduce various techniques for representation of the data in the real world and expose the student to efficient storage mechanisms of data for an easy access.
2.	To instill strong problem solving techniques using data structures, algorithms, and time-complexity.
Syllabus:	
Unit 1	**Introduction**
	Need of data structures, hardware and software implementations of data structures, various existing data structures and their related operations, compile time memory allocation and dynamic (run time) memory allocation, garbage collection.
Unit 2	**Linked list**
	Linked array and pointer representations their advantages and disadvantages, creation traversal, insertion and deletion, sorting, concatenation, merging, searching, header node, link list with grounded header node, circular link list, Josephus doubly linked (two way) link, its advantages and disadvantages.

Unit 3	**Stack**
	Array representation, overflow and underflow, push and pop operations, recursion its advantages, converting a recursive procedure to a non-recursive procedure.
Unit 4	**Queue**
	Simple queue, addition to a queue, removal from a queue, de-queues, input restricted and output restricted de-queues, addition and removal w.r.t. de-queue.
Unit 5	**Tree**
	Basic definitions, representation in computer memory, creating a binary tree, traversal algorithms threading in a binary tree, heap tree, creation of heap tree, inserting a node in a heap tree, deleting the root of heap tree, heap sort algorithm, link list representation using binary tree, multi-way search tree, representation in computer memory and its advantages.
Unit 6	**Graph**
	Basic definitions, representation in computer memory, creation of a graph, traversal in a graph, depth first traversal and breadth first traversal, sorting, inserting an arc in a graph, deleting an arc from a graph, searching a node and an arc in a graph.
Unit 7	**Searching algorithms**
	Sequential search, binary search, efficiency of searching algorithms, improving the efficiency of sequential search by move to front, move forward, indexed sequential search.
Unit 8	**Table data structure**
	Hash function and hashing, selection of hash function, collision and collision resolving methodologies, linear probing, quadratic probing, buckets, chaining, storing (inserting) data in table, searching a data record in a table, deleting a data record from a table, efficiency of search.
Unit 9	**Sorting algorithms**
	Bubble sort, quick sort, heap sort, insertion sort, selection sort, merge sort, efficiency of sorting algorithms.
Reference Books:	
1.	Cormen, Leiserson, and Rivest, "Introduction to Algorithms", Second Edition, Mc Graw Hill, New York, New Delhi, 1990.
2.	Ronald L. Rivest, Algorithms, "Data structures and Programs", Prentice Hall, New Jersey, 1990.
3.	Horowitz, Sahni, and Rajasekaran, "Fundamentals of Algorithms", Galgotia Publications, New Delhi, 1999.
Course outcomes:	
1.	To define and analyze various data structures and abstract data types including lists, stacks, queues, trees, and graphs.
2.	To understand instrumentation & control engineering problems from a computational perspective.
3.	To execute vast set of sorting and searching algorithms useful for various engineering applications.
4.	To analyze and implement learned algorithm design techniques and data structures to solve problems.

5.	To select the appropriate data structure and algorithm design method for a specified application.
6.	To design and implement various basic and advanced data structures.

IN313 Seminar

Teaching scheme:			**Examination scheme:**
Lectures	0	hrs/week	
Tutorials	0	hrs/week	
Practical	2	hrs/week	
Credits	1		

Syllabus:

The seminar will consist of a report of about 25 typewritten pages based on Survey of latest developments in a specific field of instrumentation and control systems.

OR

Investigation of practical problems in the manufacturing and or testing of an instrument.

OR

Design modification of an existing equipment/instrument.

AND

Seminar on one of the following topics should be delivered (without report)

- Entrepreneurship
- Personality development
- Value education
- Life profiles of eminent personalities like Lokmanya Tilak, Swami Vivekanand, Arvind Ghosh, A.P. J. Abdul Kalam
- Stories of successful Entrepreneurs
- Stories of scientists/renowned persons

HU301 Humanity Science

Teaching scheme:			**Examination scheme:**
Lectures	2	hrs/week	**Theory**
Tutorials	0	hrs/week	**Mid Term :**
Practical	0	hrs/week	**End Sem. Exam:**
Credits	**Audit Course**		

1.	Importance of attitude: building positive attitude, self esteem.
2.	Cultural heritage of India : cultural tenets, values, peculiarities, family unit, old scriptures.
3.	Ancient science and technology: astronomy, physics, chemistry, mathematics, ayurveda, Kanad's atom theory, Aryabhatt, viman shastra surgery etc.
4.	Vedic mathematics.
5.	Life management techniques as preached by Saints, western philosophers etc.
6.	Motivation: How does it work, stages from motivation to demotivation, motivational stories.
7.	Goal setting of life: Why goals are important?, Why don't more people set goals, goals must be balanced.
8.	Problems before the nation and role of an individual.

9.	Culture and different isms: Indian culture, communism, Socialism, capitalism.
10.	Role of media and expectations.
11.	Theory "i'' Management.
12.	Science and spirituality: stress management.
Reference Books:	
1.	India vision 2020 by Dr APJ Abdul Kalam.
2.	Ancient science and technology By Dr. Gopalkrishnan.
3.	Theory of I management by Arindam Choudhary.
4.	India: what it can teach us by Maxmuller.
5.	Third way by Datopant Tengati.
6.	Swami Vivekananda(2004), Collected Works (Commentary on Yogasutras, vol.), Ramakrishna Mission, Kolkata.
7.	Gita-pravacane.
8.	Upanishadaancaa Abhyaasa.
9.	Gitaaii Cintanikaa.
10.	A Constructive Survey of Upanishadic Philosophy.
11.	Bhagvadgita: Saakshaatkaaradarshana.