B.TECH (FOUR YEAR COURSE) &
B.TECH (SIX YEAR DOUBLE DEGREE COURSE)
(With effect from **2019-2020** admitted batches onwards)
Under Choice Based Credit System.

B.Tech – INSTRUMENTATION ENGINEERING

B.TECH. 1/4: **SEMISTER -I**

Code Number	Course	L	T	P	Allotment of Marks		Total Marks	Ext. Exam Time	C
		Hrs per week			Ses.	Ext.			
ENG1101*	Mathematics-1	3	0	0	30	70	100	3 Hrs	3
ENG1102*	Mathematics-2	3	0	0	30	70	100	3 Hrs	3
ENG1104	Physics	3	1	0	30	70	100	3 Hrs	4
ENG1106	Engineering Graphics	2	0	4	30	70	100	3 Hrs	4
ENG1108	Professional Ethics and Moral Values	2	0	0	30	70	100	3 Hrs	0
ENG1111	Physics Lab	0	0	3	50	50	100	3 Hrs	1.5
ENG1113	Workshop	0	0	3	50	50	100	3 Hrs	1.5
	Total	13	1	10	250	450	700		17

L: Lectures; T: Tutorial; P: Practical; Ses: Sessionals; Ext: External; C: Credits
* Common to Both Group-A and Group-B

B.TECH. 1/4: **SEMISTER -II**

Code Number	Course	L	T	P	Allotment of Marks		Total Marks	Ext. Exam Time	C
		Hours per week			Ses.	Ext.			
ENG1201*	Mathematics-3	3	1	0	30	70	100	3 Hrs	4
ENG1202	Chemistry	3	1	0	30	70	100	3 Hrs	4
ENG1204	Computer Programming Using C and Numerical Methods	3	0	0	30	70	100	3 Hrs	3
ENG1206#	Department Subject	3	1	0	30	70	100	3 Hrs	4
ENG1207	Essence of Indian Tradition Knowledge	2	0	0	30	70	100	3 Hrs	0
ENG1209	English	3	0	0	30	70	100	3 Hrs	3
ENG1210	Chemistry Lab	0	0	3	50	50	100	3 Hrs	1.5
ENG1212	Computer Programming Using C and Numerical Methods Lab	0	0	3	50	50	100	3 Hrs	1.5
	Total	17	3	6	280	520	800		21

Department subject: ENG1206: Basic Electronics and Digital Systems.

B.TECH. 2/4: **SEMISTER -I**

Code Number	Course	L	T	P	Tot. Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext. Marks	Marks	Time	
INE 211	Mathematics-IV	3	0	0	3	30	70	100	3 Hrs	3
INE 212	Material Science	3	0	0	3	30	70	100	3 Hrs	3
INE 213	Strength of Materials And Theory of Machines	3	0	0	3	30	70	100	3 Hrs	3
INE 214	Electrical Machines	3	0	0	3	30	70	100	3 Hrs	3
INE 215	Sensors and Transducers	3	0	0	3	30	70	100	3 Hrs	3
INE 216	Humanities -1	3	0	0	3	30	70	100	3 Hrs	3
INE 217	Basic Electronics Lab	0	0	4	4	50	50	100	3 Hrs	2
INE 218	Electrical Machines Lab	0	0	4	4	50	50	100	3 Hrs	2
	Total	18	0	8	26	280	520	800		22

B.TECH. 2/4: **SEMISTER -II**

Code Number	Course	L	T	P	Tot.Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext.Marks	Marks	Time	
INE 221	Environmental Science and Engineering	3	0	0	3	-	-	-	-	-
INE 222	Electrical Measurements and Measuring Instruments	3	0	0	3	30	70	100	3 Hrs	3
INE 223	Operational Amplifiers & Linear IC Applications	3	0	0	3	30	70	100	3 Hrs	3
INE 224	Signals and systems	3	0	0	3	30	70	100	3 Hrs	3
INE 225	Industrial Instrumentation	3	0	0	3	30	70	100	3 Hrs	3
INE 226	Electronic Instrumentation	3	0	0	3	30	70	100	3 Hrs	3
INE 227	Industrial Instrumentation Lab-1	0	0	4	4	50	50	100	3 Hrs	2
INE 228	Digital Electronics Lab	0	0	4	4	50	50	100	3 Hrs	2
	Total	18	0	8	26	250	450	700		19

B.TECH. 3/4: **SEMISTER -I**

Code Number	Course	L	T	P	Tot.Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext. Marks	Marks	Time	
INE 311	Control Systems	3	0	0	3	30	70	100	3 Hrs	3
INE 312	Microprocessor and Micro Controllers	3	0	0	3	30	70	100	3 Hrs	3
INE 313	Industrial Electronics	3	0	0	3	30	70	100	3 Hrs	3
INE 314	Analytical Instrumentation	3	0	0	3	30	70	100	3 Hrs	3
INE 315	Advanced Sensors	3	0	0	3	30	70	100	3 Hrs	3
INE 316	**Elective-I**	3	0	0	3	30	70	100	3 Hrs	3
INE 317	Constitution of Indian/ Essence of Indian traditional Knowledge	--	--	--	--	--	--	--	--	--
INE 318	Industrial Instruments Lab- II	0	0	4	4	50	50	100	3 Hrs	2
INE 319	Control System Lab	0	0	4	4	50	50	100	3 Hrs	2
	Total	18	0	8	26	280	520	800		22

INE 316: **Elective-I**

a) Computer organization & OS. b) Analog Signal Processing. c) Virtual Instrumentation.

B.TECH. 3/4: **SEMISTER -II**

Code Number	Course	L	T	P	Tot.Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext. Marks	Marks	Time	
INE 321	Digital Signal Processing	3	0	0	3	30	70	100	3 Hrs	3
INE 322	Process Control And Control Components	3	0	0	3	30	70	100	3 Hrs	3
INE 323	**Elective –II**	3	0	0	3	30	70	100	3 Hrs	3
INE 324	**Elective-III**	3	0	0	3	30	70	100	3 Hrs	3
INE 325	**Open Elective - 1**	3	0	0	3	30	70	100	3 Hrs	3
INE 326	**Project-I**	0	0	4	4	50	50	100	3 Hrs	3
INE 327	Micro process Lab	0	0	4	4	50	50	100	3 Hrs	2
INE 328	Virtual Instrumentation Lab	0	0	4	4	50	50	100	3 Hrs	2
	Total	15	0	12	27	300	500	800		22

INE 323: Elective –II

a) Power Plant Instrumentation. b) Non-Destructive Testing. C) Fundamentals of Nano Sensors.

INE 324: Elective –III

a) Advance Control Theory. b) Advanced Sensing Techniques. C) Design of Instrument Systems.

INE 325: Open Elective - 1 Humanities and Management Course.

B.TECH. 4/4: **SEMISTER -I**

Code Number	Course	L	T	P	Tot.Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext. Marks	Marks	Time	
INE 411	**Elective- IV**	3	1	0	4	30	70	100	3 Hrs	3
INE 412	**Elective- V**	3	1	0	4	30	70	100	3 Hrs	3
INE 413	**Open Elective -2**	3	1	0	4	30	70	100	3 Hrs	3
INE 414	Biomedical Instrumentation	3	1	0	4	30	70	100	3 Hrs	3
INE 415	**Project- 2**	-	-	12	12	50	50	100	3 Hrs	6
INE 416	Biomedical Instrumentation Lab	0	0	3	3	30	70	100	3 Hrs	3
INE 417	Process Control Lab	0	0	3	3	50	50	100	3 Hrs	2
	Total	12	4	18	34	280	520	800		22

INE 411: Elective –IV

A) Instrument Data Networks. B) Digital Image Processing C) Micro and Nano Sensors.

INE 412: Elective –V

A) Telemetry B) Artificial Intelligence C) Fiber Optics and Sensors.

INE 413: Open Elective - 2 IoT Sensors and Devices.

B.TECH. 4/4: **SEMISTER -II**

Code Number	Course	L	T	P	Tot.Hrs.	University Examinations				C
		Hours per week				Ses. Marks	Ext. Marks	Marks	Time	
INE 421	**Elective- VI**	3	1	0	4	30	70	100	3 Hrs	3
INE 422	**Open Elective- 3**	3	1	0	4	30	70	100	3 Hrs	3
INE 423	**Open Elective- 4**	3	1	0	4	30	70	100	3 Hrs	3
INE 425	**Project- 3**	-	-	12	12	50	50	100	3 Hrs	6
INE 427	DCS & PLC lab	0	0	3	3	50	50	100	3 Hrs	2
	Total	9	3	15	27	190	310	500		17

INE 421: Elective- VI

a) Steel Plant Instrumentation b) Industrial Safety Instruments c) Robots & Computer Control of Machine Parts

INE 422: Open Elective- 3 Programmable Control System

INE 423: Open Elective- 4 VLSI

Course Total Credits	**161**

INE : 211 MATHEMATICS-IV

INE 212 MATERIAL SCIENCE

L	T	PD	TOTAL Pds	Univ Exam		Sessnl Marks	Total Marks
				Hrs	Marks		
3	1	--	4	3	70	30	100

MECHANICAL PROPERTIES: Tensile Testing-Impact Testing-hardness Tests-Brinell, Vickers and Rockwell tests-Plastic Deformation-Fracture toughness-Creep-fatigue-Cold work-Recovery-recrystallisation-Grain growth.

EQUILIBRIUM DIAGRAMS: Phase rule-binary Alloy Systems-Solid Solutions-Eutectic-Peritectic-Meritect-Entectoid systems-The Lever Rule-Micro Structural development during slow cooling-Elementary metallographic.

STRUCTURAL MATERIAL: IRON-CARBON Diagram-Ferrous Alloys, Carbon and Low Alloy Steels-High alloy steels-cast irons-nonferrous Alloys-copper –Aluminum-Nickel base Alloys-bearing metals-composites.

PHASE TRANSFORMATIONS: Diffusion on solids-fick's law, Solutions to Fick's second law-applications based on second law solutions-kirkendal effect-other diffusion processes-Pearlite, Bainite and Martensite transformations in steels-Austempering and Martempering-Annealig, Normalising and Hardening methods for ferrous and nonferrous alloys-precipitation hardening.

MAGNETIC AND DIELECTRIC MATERRIALS: Ferromagnetism and related Phenomena-Domain structure-Hysteresis Loop- Soft and Hard magnetic materials-dielectric materials-polarization-temperature and frequency effects- dielectric Breakdown- Ferro Electric materials.

SEMICONDUCTORS: intrinsic and Extrinsic semiconductors-different semi conducting materials-band shapes of real semiconductors- direct and Indirect band gap materials- Fermi energy level and P-N junction diode, homojunction and Heterojunction- Transistor action.

BASIC SHAPING PROCESSES: Sand Casting- Die casting-Forging processes- Soldering and Brazing- spot welding- Arc Welding- Gas welding Processes- Powder Metallurgy Processes.

TEXT BOOKS:

1. Material Science and Engineering by V.Raghavan-prentice Hall of India, New Delhi.
2. Testing of Metallic Materials by A.V.K.SuryaNarayana, Prentice Hall of India.

REFERENCE BOOKS:

1. Introduction to Material science for Engineers by J.F.Shackelford, Macmillan publishing Co., New York.
2. Semiconductor and Electronic devices, Adir Bar-Lev, Prentice Hall of India, New Delhi.
3. Practical Experimental Metallurgy by D.Eurof Davies, Elsevier Publishing Co. Ltd., London.

INE: 213 STRENGTH OF MATERIALS AND THEORY OF MACHINES

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Simple stresses and strains – Introduction, Resistance to deformation, stresses: tensile, compressive and shear stresses. Strain: tensile, compressive and shear Strain. Elastic limit, Hooke's law, stress-strain relation, poission's ratio, Relationship between modulus of elasticity and modulus of rigidity. Stresses in bars of varying section, Stresses in bars of composite sections, temperature stresses.

Shear Force Bending Moments– Definitions, cantilever- pointed loads, uniformly distributed loads, load whose intensity varies, S.F and B.M diagrams, simply supported beams- pointed loads, uniformly distributed loads, load whose intensity varies, S.F and B.M diagrams.

Simple Mechanisms: Link and element, types of links, structure, machine, differences between machine and structure, kinematic pairs, types of constrained motions, classification of kinematic pairs, lower and higher pairs, kinematic chain, Joint, types of joint, mechanism degrees of freedom, Kutzbach criterion to plane mechanisms, Grubler's criteria, inversion of mechanisms, types of kinematic chains: four bar chain, single slider and double slider crank chains.

Mechanisms with lower pairs- pantograph, Exact straight-line mechanisms: Scott-Russel mechanism, Peaucellier mechanism, Harts mechanism, Approximate straight-line mechanisms- Modified Scott Russel mechanism, Watt mechanism, Tchebicheff's mechanism, Roberts mechanism, Grasshopper mechanism.

Friction and bearings- Friction definition, types, laws of Friction, limiting friction, limiting angle of Friction, angle of repose, minimum force required to move a body on a rough horizontal plane, Friction of a body on a rough inclined plane: up the plane, down the plane, efficiency of inclined plane, Screw friction, screw jack, friction in journal bearings, friction circle.

TEXT BOOKS:

1. Strength of Materials- S.Ramamrutham
2. Strength of materials- J.A.Taraporebala
3. Machines of structures- S.B.Junnarkar-
4. Theory of machines- Toft.L. and Kersy A.T.J
5. Theory of machines - R.S.Kurmi and J.K.Gupta

INE: 214 ELECTRICAL MACHINES

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit 1: POLYPHASE CIRCUITS
Star and why connections, vector diagrams, phase sequence, voltage, current relations in two phase and three phase circuits. Analysis of balanced three phase circuits. Measurements of power in three phase circuits.

Unit 2: TRANSFORMERS
Single phase transformer-construction-voltage equation, transformer on no-load and full-load. Equivalent circuit – losses- efficiency-auto transformer, use of transformers with instruments-testing of transformer – Short circuit test and open circuit test.

Unit 3: D.C.Machines
DC Generator – construction - armature windings – principle - e.m.f equation-armature reaction (in brief) and commutation- losses - efficiency - Generator characteristics
D.C.motor – construction- back e.m.f- - losses – efficiency- speed torque characteristics-starters-speed control testing.

Unit 4: Synchronous machines-
Alternators- principle and working - synchronous impedance-armature reaction (in brief) - e.m.f.equation-synchronous motor, nature of torque, vector diagram-characteristics of a synchronous motors-starting methods.

Unit 5: Induction motor-construction-theory of induction motor –efficiency-equivalent circuit and speed control.

TEXT BOOKS:

1. Electrical technology by B.L.Theraja.
2. Electrical technology by H.Cotton.
3. Electrical machinery by Fitzgerald/kingsley/umans.
4. Electrical machinery by Irving L.Kosow.

INE: 215 SENSORS AND TRANSDUCERS

L	T	PD	TOTAL Pds	Univ Exam		Sessnl Marks	Total Marks
				Hrs	Marks		
3	1	--	4	3	70	30	100

Unit I: Measurements and Measurement systems- functional elements of measurement system-classification of measuring instruments- specifications of measuring instruments- Standards of measurement-calibrations of measuring instruments- static and dynamic characteristics of measurement systems-errors in measurement systems.

Unit II: Mathematical modeling of measurement systems- Modeling of mechanical systems-electrical system-thermal systems and fluidic systems- order of measurement systems –zero order,1st order, 2nd order and higher order systems – transfer function of measurement systems – system response to standard test signals – response of 1st order and second order systems for standard test signals.

Unit III: Transducers-Active and passive transducers – Transducers- characteristics- basic requirements resistive transducers- strain gaues- potentiometers RTD's and thermistors – Inductive transducers- self-inductance and variable inductance transducers _LVDT and its applications – capacitive transducers- variable distance and variable area and dielective type

Unit IV: Piezo electric transducers and their applications- magnetic strictive- thermo electric and hall effect transducers- photo electric transducers- photo emissive and photo voltaic types and their applications- advanced sensors smart transducers- intelligent transducers and MEMS sensors.

Unit V: Measurement of force, stress& strained torque ,Velocity and Speed Measurement - : Basic methods of force measurement, elastic force traducers, strain gauge, load cells, shear web, piezoelectric force transducers, vibrating wire force transducers, Strain gauge torque meter, Inductive torque meter, Magneto-strictive transducers, torsion bar dynamometer, etc. Dynamometer (servo control and absorption) instantaneous power measurement and alternator power measurement. Contact and ??Noncontact types of speed measurement

TEXT BOOKS:

1. A Course in Mechanical Measurements and Instrumentation – A.K.Sawhney
2. Instrumentation-Devices and Systems--C. S. *Rangan*,G. R. Sarma,V. S. V. *Mani*

REFERENCE BOOKS

1. Measurement Systems: Application and Design – E.O.Doeblin..
2. Transducers and Instrumentation-D.V.S.Murthy
3. Principles of Industrial Instrumentation-D.Patranabis.

INE: 216 **HUMANITIES -1**

L	T	PD	TOTAL Pds	Univ Exam		Sessnl Marks	Total Marks
				Hrs	Marks		
3	1	--	4	3	70	30	100

INE: 221 **ENVIRONMENTAL SCIENCE AND ENGINEERING**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Introduction: Definition, scope and importance, Measuring and defining, environmental development indicators

Ecosystems: Introduction, types, characteristic features, structure and functions of Ecosystems Forest, Grassland, Desert, Aquatic (lakes, rivers, and estuaries)

Environment and Natural resources management: Land resources: Land as a resource, Common property resources, Land degradation, Soil erosion and desertification, Effects of modern agriculture, fertilizer-pesticide problems. Forest resources: Use and over-exploitation Mining and dams-their effects on forest and tribal people

Water resources: Use and over-utilization of surface and ground water, Floods and droughts, Water logging and salinity, Dams –benefits and costs, Conflicts over water

Energy resources: Energy needs, Renewable and non-renewable energy sources, Use of alternate energy sources, Impact of energy use on environment

Bio-diversity and its conservation: Value of bio-diversity-consumptive and productive use, social, ethical, aesthetic and option values. Bio-geographical classification of India as a mega diversity habitat. Threats to biodiversity-hot spots, habitat loss, poaching of wildlife, loss of species, seeds, etc. Conservation of bio-diversity-In-situ and Ex-situ conservation

Environmental pollution-local and Global Issues: Causes, effects and control measures of: Air pollution, Indoor air pollution, Water pollution, soil pollution, Marine pollution, Noise pollution

Solid waste management, composing, vermiculture, Urban and industrial wastes, recycling and re-use. Nature of thermal pollution and nuclear hazards ,Global Warming, Acid rain ,Ozone depletion

Environmental problems in India: Drinking water, sanitation and public health, Effects of activities on the quality of environment: Urbanization, Transportation, Industrialization, Green revolution, Water scarcity and ground water depletion, Controversies on major dams, resettlement and rehabilitation of people, problems and concerns. Rain water harvesting, cloud seeding and watershed management

Economy and Environment: The economy and environment interaction, Economics of development, preservation and conservation, Sustainability: theory and practice, Limits to growth

Equitable use of resources for sustainable lifestyles, Environmental impact Assessment

Social Issues and the environment: Population growth and environment**,** Environmental education**,** Environmental movements**,** Environment vs Development

Institutions and governance: Regulation by Government**,** Monitoring and Enforcement of Environmental regulation**,** Environmental acts: Water (prevention and control of pollution) act

Air (prevention and control pf pollution)act, Environmental Protection act, Wild life protection act,Forest conservation act,Coastal zone Regulations,Institutions and policies relating to India, Environmental Governance

International Conventions: Stockholm Conference 1972, Earth Summit 1992, World Commission for Environmental Development (WCED)

Case Studies: Chipko Movement, Narmada BachaoAndolan,Silent Valley project, Madhura Refinery and Taj Mahal, Industrialization of Pattancheru, Nuclear reactor at Nagarjuna Sagar,Tehri Dam, Ralegaon Siddhi(Anna Hazare), Kolleru Lake-aqua culture, Fluorosis in Andhra Pradesh

Field work: Visit to a local area to document and mapping environmental, Asscts river / forest / grass land / hill / mountain, Study of local environment – common plants, insects, birds, Study of simple ecosystems – pond, river, hill, slopes etc. Visits to Industries, Water treatment plants, affluent treatment plants. (5lectures)

INE: 222 - ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit 1: MEASUREMENT OF RESITANCE, CAPACITANCE AND INDUCTANCE: D.C bridges, potentiometers, A.C bridges, measurement of inductance and capacitance, errors in bridge measurements, Wagner's earthing device.

Unit 2:CLASSIFICATION OF INSTRUMENTS: Electrical analog instruments, classification and constructional details, galvanometers, operating principle dynamic response, measurement of galvanometer constants

Unit 3: MEASUREMENT OF VOLTAGE AND CURRENT: moving-iron, PMMC, Electro dynamic, electro static and inductive type instruments, range extension

Unit 4: MEASUREMENT OF POWER: Watt meters, dynamometer induction electrostatic watt meters, poly phase watt meters.

Unit 5: MEASUREMNT OF ENERGY: induction watt-hour meter-errors and compensation, polyphase induction watt-hour meter, measurement of frequency, phase angle, power factor, special purpose instruments.

TEXT BOOKS:

1. Electrical measurement and measuring Instruments by Golding and Widdis.
2. Electrical and Electronic measurements and Instruments By A.K.Sawhney.
3. Electrical measurements and Measuring instruments By Rajendra Prasad.

INE: 223 - OP AMPS AND LINEAR INTEGRATED CIRCUITS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

INTRODUCTION TO Op-AMP: Block diagram of typical op-amp types of integrated circuits, Electrical characteristics of an op-amp, ideal voltage transfer curve, open loop differential amplifier configuration. The open loop inverting and non-inverting amplifier configuration.

AN OP-AMP WITH NEGATIVE FEEDBACK: Block diagram of feedback configuration voltage-series feedback amplifier analysis, voltage shunt feedback amplifier analysis. Basic differential amplifier.

THE PRACTICAL OP-AMP: Offset voltages, offset voltage null circuit, offset voltage compensating network, configurations of inverting and non- inverting amplifiers with feedback and offset- voltage compensation, thermal drift noise.

GENERAL LINEAR APPLICATIONS OF OP-AMP: DC and AC amplifiers, the peaking amplifier, summing, scaling and averaging amplifiers, subtractor, V/I converter with floating load, sample and hold circuit, low-voltage DC and AC voltmeters, V/I converter with ground load, I/V converter, Instrumentation amplifier. The differentiator, Integrator.

ACTIVE FILTERS: First and Second order low pass filter butter worth filters, first and second order high pass butter worth filter, high order filters, wide band-pass, narrow band-pass filter, wide band-reject filter, narrow band reject filter.

SPECIALIZED IC APPLICATIONS: Basic Comparator, Zerocrossing detector, Schmitt Trigger, 555 Timer- astable& mono stable pulse generators, the 555 as square wave generator, 555 as free running ramp generators, block diagram of a phase locked loop and its operating principle.

TEXT BOOKS:

1. Op-amps and linear integrated circuits by RamaKantA.Gayakwad, P.H.I.
2. Op-amps and linear integrated circuits by Robert Coughlin.
3. Applications of analog integrated circuits by Sidneysoclof PHI.
4. Linear Integrated circuits by D Roy Choudhury, ShailBala Jain.

INE: 224 **SIGNALS & SYSTEMS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	**1**	**--**	**4**	**3**	**70**	**30**	**100**

UNIT-1: Signals and Systems- An Introduction - A signal, types of signals, standard signals, representation of discrete-time signals, elementary discrete –time signals, basic operations on signals, classification of signals, A system, classification of systems, basic system properties, system modeling.

UNIT-II: Time Domain Analysis of Discrete- Time Systems - Solution of Difference Equations, Impulse Response, representation of discrete time signals interms of impulses, convolution sum, properties of convolution sum, convolution of two sequences, causality, stability, BIIIBO stability criterion, step response, correlation of two sequences, Inverse system and Deconvolution.

UNIT- III: Time Domain Analysis of Continuous –Time Systems - Introduction, solution of differential equations, convolution integrals, properties of convolution integral, impulse response, of interconnected systems, causality, stability, step response, graphical procedure to perform convolution.

UNIT-IV: Fourier Series Analysis of CT periodic signals - Introduction, evaluation of Fourier coefficients, symmetry conditions, cosine representation, exponential Fourier Series, Existence of Fourier Series, properties of CT Fourier series, power representation using Fourier series, Fourier Spectrum.

UNIT – V: The Continuous – Time Fourier Transforms - Existence of Fourier Transform, Fourier Transform of some standard signals, properties of Fourier Transform, Fourier Transform of periodic signals, modulation, system analysis with Fourier Transform.

UNIT-VI: Laplace Transform Analysis of Signals and Systems - Introduction, convergence of Laplace Transform, The unilateral Laplace transform, Inversion of unilateral Laplace transform, inversion of bilateral Laplace Transforms, solution of differential equations using Laplace Transform.

TEXT BOOKS:

1. Signals and systems – by A.V Oppenheim , AS Willesky& SH Nawab, PHI

REFERENCE:

1. Signals and Systems by Simon Haykins and Bary Van Veen, Wiely-India Publications.
2. Linear Systems and Signals by BP Lathi, Oxford University press.
3. Signals and systems by P.RameshBabu and R.Aanada Natarajan, 3rd Edition, Scitech.

INE: 225 **INDUSTRIAL INSTRUMENTATION**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	**1**	**--**	**4**	**3**	**70**	**30**	**100**

Selection of Measuring and Test Equipment & Calibration procedures: Identification of Measurement needs, Formulating Specifications, Evaluation of M & TE and Calibration procedure formats

Vibration and Acceleration measurement: Standards, working principle, types, materials, design criterion: Eddy current type, piezoelectric type, Seismic Transducer, Accelerometer: Potentiometric type, LVDT type, Piezo-electric type.

Pressure measurement: Elastic types-Resistive- Capacitive and Inductive pressure pickups. Piezoelectric- Piezoresistive types. Vacuum measurement: McLeod gauges-Ionization gauges-Alphatron gauge. High Pressure measurement. Force balance and Motion balance type transmitters – P/I and I/P converters. IC pressure sensors and calibration of pressure measuring devices.

Temperature measurement: Filled-in thermal systems- Bimetallic thermometers - RTD, Thermistor, Thermocouple - Radiation and Optical pyrometers - Digital IC thermometers - Accuracy, errors and compensation.

Flow measurement: Head flow meters- types, Area flow meters– Rotameter bypass rotameter-Turbine meter. Electromagnetic flowmeter – Principle – DC AC and pulsed type. Ultrasonic flow meters – Principles – transit time – Doppler shift – beam deflection– Cross correlation flowmeters. Vortex flowmeters -Coriolis flowmeters- Solid flow measurement-conveyor belt type. Installation and Calibration procedures of various flowmeters

Level Measurement: Conductive and Capacitive methods –Ultrasonic, Microwave and RADAR level sensors - Solid level measurement by Paddlers method. Capacitance method for powder level measurement. Density, Viscosity and PH measurement.

Allied Sensors: leak detector, flame detector, smoke detector, density, , Sound sensors, and Proximity sensors , Gas Sensors and digital transducers

TEXT BOOKS:

1. Industrial Instrumentation – D.Patranabis.
2. A Course on Electrical and Electronic Measurements and Instrumentation -A.K.Sawhney.
3. Instrumentation Devices and Systems – C.S.Rangan. , Mani, Sharma

REFERENCE BOOKS

1. Mechanical and Industrial Instruments – R.K Jain.
2. Process Instrumentation and Analysis – G.B.Liptak.
3. Sensors and Transducer – D.Patranabis.
4. Transducers and Instrumentation – D.V.S. Murthy.

INE: 226 **ELECTRONIC INSTRUMENTATION**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	**1**	**--**	**4**	**3**	**70**	**30**	**100**

Generalised Instrumentation system – Units and standards- Calibration methods- Standards of measurement- Classification, Introduction to mechanical, electrical and electronic instruments.

Cathode ray oscilloscope: Block diagram vertical and horizontal amplifiers, sweep circuits, delay line, electrostatic focusing and electrostatic deflection. Special purpose oscilloscopes- sampling oscilloscopes, analog storage and digital storage oscilloscopes, dual beam and dual trace oscilloscopes.

Instruments for generating and analyzing wave forms, square wave, pulse, standard-signal, random noise and function generators, wave analysers, spectrum analysers, Q-meters, vector – voltmeters, vector impedance meters.

Electronic analog meters: Electronic voltmeters VTVM, TVM, FETVM Voltmeters, electronic – multimeters differential voltmeters. DC voltmeters- Loading- Transfer volt meter- Chopper type– Differential voltmeter – Peak responding voltmeter – True RMS voltmeter – Calibration of DC instruments.

Digital Instruments: – Digital multimeters – Digital frequency meter – Digital Measurement of time – Universal counter – Electronic counter – Digital Tachometer- Digital voltmeter– Ramp Type DVM – Dual slope Ramp DVM- Integrating type DVM – Successive approximations type DVM – Resolution and sensitivity of digital meters – General specifications of a DVM, Data acquisition system.

TEXT BOOKS:

1. Modern electronic instrumentation measurements techniques by Helfrick and cooper.
2. A course in electrical and electronic measurement and instrumentation by A.K.Shawney.
3. Electronic Instrumentation by H.S.Kalsi.

INE: 311 **CONTROL SYSTEMS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit 1: The control systems, closed loop control, open loop control, servo mechanisms, Differential equations of physical systems

Unit 2: Transfer functions, procedure for deriving transfer functions, Block diagram, algebra, signal flow graphs, Mason's gain formula, application of signal flow graph to control systems.

Unit 3: Time Response: Time domain specifications, types of test inputs, 1 and II order system response, error coefficients, steady state error. The Root locus concept, construction of root loci, construction rules, determination of roots from root locus.

Unit 4: The concept of stability, necessary conditions for stability, Hurwitz stability criterion, Routh stability criterion, application of a Routh stability criterion to Linear feedback systems, Relation between time and frequency response, polar plots.

Unit 5: Bode plots, Nyquist stability criterion, gain margin and phase margin, closed loop frequency response.

TEXT BOOKS:

1. Nagarath IJ and Gopal M – Control systems and Engineering, Willey Eastern, 1985.
2. Ogata K – Modern control Engineering 2nd Edition PHI – 1995.

INE: 312 **MICROPROCESSOR AND MICRO CONTROLLERS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit I: introduction to microprocessors- microprocessor architecture-address, data and control buses-8bit microprocessors -8085- architecture- addressing modes- instruction set – programming –stacks and subroutines-interrupts of 8085.

Unit II: Interfacing concepts-memory interfacing-I/O interfacing methods-memory mapped I/O and direct I/O-types of I/O-simple, polled and interrupt I/O-DMA. Interfacing, keyboard and led interfacing data converter interfacing - (hardware and software).

Unit III: Data communication with parallel and serial devices-8255A PPI, 8253-programmable interval timer, 8257 programmable DMA controller interface-8259 programmable interrupt controller-8251 USART serial interfacing device.

Unit IV: 16-bit microprocessors-8086 architecture-instruction set-80286 microprocessor-Real and PVAM mode of operation -80386 microprocessor and its features-paged addressing mode-80486 processor and its cache organization.

UNIT V: Microcontrollers- 8bit microcontyrollers-8051 architecture-program memory-data memory organization-addressing modes- Timers/Counters organization, serial I/O organization-Interrupt handling- advanced microcontrollers-8096-PIC microcontrollers-AT mega controllers and their features.

REFERENCE BOOKS:

1. Microprocessors architecture, programming and applications – R. S. Goankar – Wiley Eastern India Publications.
2. Microprocessors and digital systems – 2nd edition – D.V. Hall, McGraw Hill Publications.
3. Fundamentals of microprocessors and microcomputers – Badri Ram Dhanpat Rai &sons publications.

INE: 313 **INDUSTRIAL ELECTRONICS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

INTRODUCTION TO INDUSTRIAL ELECTRONICS: Scope of Industrial Electronics, Main task of Power Electronics, Applications, Advantages, Disadvantages, Applications, Block diagram of Power Electronic System, PNPN device- Basic structure, two transistor version, Volt Ampere Characteristics, Holding current. Latching current, Gate circuit of Thyristor, Thyristor gate characteristics, Design of firing circuit, Triggering methods of thyristor, thyristor connected in series and parallel, Thyristor ratings, Silicon Controlled Switch(SCS): Basic structure, Two transistor equivalent, characteristics, Uni-junction transistor- Basic structure, Potential divider equivalent, Static emitter characteristics, delay firing of SCR by UJT. Bilateral PNPN diode switch(DIAC): Basic structure, Volt-Ampere characteristics, Traic- Basic structure, Volt-Ampere characteristics.

POLYPHASE RECTIFIERS: Introduction, uses of Polyphase Rectifiers, Three phase half wave delta-wye rectifier with resistive load, Six -phase star Half wave rectifier with resistive load, Delta line to line double wye half wave rectifier with inter phase transformer and with resistive load, Three phase delta wye bridge rectifier with resistive load, General m-phase rectifier DC power outputs, efficiencies and ripple factors, Transformer utility factor, Rectifier performance, Commutation in Polyphase rectifiers.

ELECTRIC WELDING AND HIGH FREQUENCY HEATING: Methods of high frequency heating, Welding: Plastic Welding, Fusion Welding, Basic block diagram for a.c. resistance welding, types: Spot welding. Projection welding. Butt welding, Seam welding and Pulsating welding arrangements. Induction Heating: Principle of induction heating. Applications. Dielectric Heating: Principle of dielectric heating. Electrodes used in dielectric heating. Methods of coupling of Electrodes to R.F. Generator. Applications.

VOLTAGE CONTROLLED RECTIFIERS: (outlines of topics only): Single-Phase Half-wave controlled rectifier with resistance load. Single-Phase Full-wave controlled rectifier with resistance load. Three-Phase Half wave controlled rectifier with resistance load. Six-phase half-wave Controlled rectifier with resistance load.

ELECTRONIC SPEED CONTROL OF MOTORS: (outlines of topics only): DC Motor speed Control: single phase dc drives, single phase half wave converter drives, phase control, SCR feedback circuit for series motor drive. Half wave controlled SCR bridge for series motor drive. Chopper controlled dc drives. AC motor speed control- Speed control by variation of

stator voltage using SCRs, Variable-frequency A.C motor drive, Voltage-fed inverter control. P.W.M. control scheme, Current-fed inverter control, chopper controlled wound rotor Induction motor, rotor resistance control.

TEXT BOOKS:

1. 1.Industrial Electronics and by Power Electronics G.K.mithal, Khanna publishers.
2. Power Electronics by P.C.Sen, T.M.H.
3. Power Electronics by Dr.P.S.Bimbra, Khanna publishers

INE: 314 **ANALYTICAL INSTRUMENTATION**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Introduction, laboratory and industrial analzers classification of the methods of analysis block diagram of an analysing system. Colorimeters & Spectrophotometers (visible & ultraviolet) electromagnetic radiation, the Beer Lambert law. Infra - red spectrophotometers types of instruments, principles of operation, basic components of the systems.

Nuclear magnetic resonance spectrophotometer (NMR) principle, construction, details Fourier transform NMR, spectroscopy computerized NMR. Electro spin resonance spectrometer (ESR), principle of operation construction of the ESR spectrometer.

X-ray spectrometer: X-ray spectrum, instrumentation for X-ray spectrometry X-ray diffractometers X-ray absorption meters X-ray fluorescence spectrometers.

Gas & liquid chromatographic systems: Principles of chromatography, Schemes and constructional details and functions of chromatographic system components.

Systems working on thermal conductivity. Principle of operation- conductivity cell construction-Measuring circuits. electro-chemical cell, construction. conductivity meters, polarography.

PH MEASURING SYSTEMS: Principles of PH measuring electrodes, measuring-reference-selective ion type measuring circuits, industrial PH-meters

INDUSTRIAL GAS ANALYZERS: Types of gas analyzers- flue gas analyzers, paramagnetic oxygen analyzers, electrochemical gas analyzers. Hydrogen gas analyzers-IR gas analyzers, analyzers based on gas density systems based on ionization of gases.

ENVIRONMENTAL POLLUTION MONITORING INSTRUMENTS: Air pollution monitoring, instrument systems for-carbon monoxide-Sulphur dioxide-nitrogen oxides-hydro carbons-ozone automated wet chemical analyzers water pollution monitoring.

TEXT BOOKS:

1. R.S. Khandpur, Handbook of Analytical Instruments, Tata McGraw Hill publishing Co. Ltd., 2nd edition, 2006.
2. Instrumental methods of analysis - HH Willard,Jr.,JADean,FASettle,JR,CBS Publications.
3. Instrument engineers Handbook. Instrumentation and Analysis-GB Liptak Edition-Charge Chilton book Company.

INE: 315 **ADVANCED SENSORS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Chemical Sensors: Amperometry-Potentiometry-Conductivity sensors- Semi conductive sesors-MEMS sensors. Materials for sensors-Electrical conducting materials- Ionic conductors-zirconia-alumina-NASICON. Semiconductor materials-Titania-tinoxide-zinc oxide. Insulating materials-Ferroelectric Materials-Negative temperature ceramic thermistors.

Thin and Thick film sensors: Thick film processes-Thin film processes- Thin film deposition methods- thin film characterization methods-thin film delineation techniques-compatibility issues- Longmuir-Blodgett films for sensor materials-film forming apparatus-dipping-ion sensors-gas sensors. Applications of thin and thick film sensors.

Biosensors: Colorimetric- Optical- Potentiometric- Amperometic- Conductometric-Semiconductor- Mechanical and Molecular electronic based sensors. Chemiluminescence based biosensors. Applications of biosensors in medical and health care- food and agricultural-Industrial process and environmental monitoring.

Integrated Magnetic Sensors: Overview of magnetic field sensor Technology-AMR-GMR-SQUIDS-Optoelectronic MFS- Semiconductor magnetic effects-materials and figure of merit-Standard MFS technologies-limitations and applications.

Sensor Applications: Automotive Sensors- Environmental Sensors- Sensors for Medical Diagnosis and patient monitoring- Aerospace sensors.

REFERENCE BOOKS

1. Sensors- A Comprehensive study-W.Gopal, J Hesse, J N Zemel –VHC Press, 1989.
2. Sensors Handbook-SabreeSoloman—McGraw Hill Publishers-1998
3. Electro Optical Instrumentation- SilvanoDonati, Pearson Education 2005.
4. Introduction to Medical Equipment Technology: Carr and Brown- Addison Weseley-2001.

INE: 316 – ELECTIVE – 1(A) COMPUTER ORGANIZATION AND OPERATING SYSTEMS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

UNIT - I:Basic Structure of Computers: Computer Types, Functional UNIT, Basic Operational Concepts, Bus, Structures, Software, Performance, Multiprocessors and Multi Computers, Data Representation, Fixed Point Representation, Floating - Point Representation.

Register Transfer Language and Micro Operations: Register Transfer Language, Register Transfer Bus and Memory Transfers, Arithmetic Micro Operations, Logic Micro Operations, Shift Micro Operations, Arithmetic Logic Shift Unit, Instruction Codes, Computer Registers Computer Instructions - Instruction Cycle.

Memory - Reference Instructions, Input - Output and Interrupt, STACK Organization, Instruction Formats, Addressing Modes, DATA Transfer and Manipulation, Program Control, Reduced Instruction Set Computer.

UNIT - II:Micro Programmed Control: Control Memory, Address Sequencing, Microprogram Examples, Design of Control Unit, Hard Wired Control, Microprogrammed Control.

The Memory System: Basic Concepts of Semiconductor RAM Memories, Read-Only Memories, Cache Memories Performance Considerations, Virtual Memories secondary Storage, Introduction to RAID.

UNIT -III: Input-Output Organization: Peripheral Devices, Input-Output Interface, Asynchronous Data Transfer Modes, Priority Interrupt, Direct Memory Access, Input-Output Processor (IOP), Serial Communication; Introduction to Peripheral Components, Interconnect (PCI) Bus, Introduction to Standard Serial Communication Protocols like RS232, USB, IEEE1394.

UNIT - IV:Operating Systems Overview: Overview of Computer Operating Systems Functions, Protection and Security, Distributed Systems, Special Purpose Systems, Operating Systems Structures-Operating System Services and Systems Calls, System Programs, Operating System Generation.

Memory Management: Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Table, Segmentation, Virtual Memmory, Demand Paging, Page-Replcement Algorithms, Allocation of Frames, Thrashing Case Studies - UNIX, Linux, Windows

Principles of Deadlock: System Model, Deadlock Characterization, Deadlock Prevention, Detection and Avoidance, Recovery from Deadlock.

UNIT - V:File System Interface: The Concept of a File, Access Methods, Directory Structure, File System Mounting, File Sharing, Protection.

File System Implementation: File System Structure, File system Implementation, Directory Implementation, Allocation Methods, Free-Space Management.

TEXT BOOKS:

1. Computer Organization - Carl Hamacher, ZvonksVranesic, SafeaZaky, 5th Edition, McGraw Hill.
2. Computer System Architecture - M. morismano, 3rd edition, Pearson
3. Operating System Concepts - AbrehamSilberchatz, Peter B. Galvin, Greg Gagne, 8th Edition, John Wiley.

REFERENCE BOOKS:

1. Computer Organization and Architecture - William Stallings 6th Edition, Pearson
2. Structured Computer Organization - Andrew S. Tanenbaum, 4th Edition, PHI
3. Fundamentals of Computer Organization and Design - SivaraamaDandamudi, Springer Int. Edition
4. Operating Systems - Internals and Design Principles, Stallings, 6th Edition - 2009, Pearson Education.
5. Modern Operating Systems, Andrew S Tanenbaum 2nd Edition, PHI
6. Principles of Operating System, B. L. Stuart, Cengage Learning, India Edition.

INE: 316 ELECTIVE – 1(B) ANALOG SIGNAL PROCESSING

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit1: Introduction to domains and the analogue/digital trade off, Introduction to basic building blocks: null or, voltage feedback amplifier, operation transconductance amplifier, current conveyor, current feedback amplifier. Analog signal filtering: introduction to bilinear transfer functions and active realizations. First-order and second-order filter realization, filter design parameters (Q and ω0), frequency response, effect of finite gain of op-amp, realization of Single-Amplifier Biquad and General Impedance Convertor circuit.

Unit2: Ideal low-pass filter, Buttreworth and Chebyshev magnitude response, pole locations, low-pass filter specifications.

Unit3: Delay equalization: equalization procedures, equalization with first-order and second-order modules, strategies for equalization design. Definition of Bode sensitivity.

Unit4: Properties of Lossless ladders, the general impedance convertor (GIC), optimal design of the GIC, realization of simple ladders, Gorski-Popiel's Embedding Technique, Bruton's FDNR technique, creating negative components.

TEXT BOOKS:

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

INE: 316 – ELECTIVE – 1(C) VIRTUAL INSTRUMENTATION

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

UNIT-I: Introduction to Virtual Instrumentation

History of Instrumentation systems, Evolution of Virtual Instrumentation, premature challenges, programming requirements, Drawbacks of recent approaches, conventional Virtual Instrumentation, Distributed Virtual Instrumentation, Virtual Instrumentation versus Traditional Instruments, Advantages.

UNIT-II: Programming Techniques

Virtual Instrumentation, Front panel, block diagram, LabVIEW environment, data flow programming, G programming.

UNIT-III: Programming Concepts of Virtual Instrumentation

VI & sub VI, loops, shift registers, feedback node, formula node, case and sequence structures, arrays, clusters.

UNIT-IV: Output Verification Tools

Waveform Graphs, Waveform charts, files I/O, local and global variables.

UNIT-V: Data Acquisition Systems

Introduction to data acquisition, data acquisition in LabVIEW, Hardware Installation and configuration, components of DAQ, DAQ Assistant, DAQ hardware.

TEXT BOOKS

1. S. Sumathi, P. Surekha, " Virtual Instrumentation with LabVIEW," ACME Learning Pvt. Ltd 2007.

REFERENCE BOOKS

1. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW," PHI learning Pvt. Ltd 2006.
2. Jeffrey Travis," LabVIEW for everyone," Pearson Education 2009.

INE: 317 – CONSTITUTION OF INDIAN/ ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

- History of Making of the Indian Constitution:
  - History
  - Drafting Committee, (Composition & Working)

- Philosophy of the Indian Constitution:
  - Preamble
  - Salient Features

- Contours of Constitutional Rights & Duties:
  - Fundamental Rights
  - Right to Equality
  - Right to Freedom
  - Right against Exploitation
  - Right to Freedom of Religion
  - Cultural and Educational Rights
  - Right to Constitutional Remedies
  - Directive Principles of State Policy
  - Fundamental Duties.

- Organs of Governance:
  - Parliament
  - Composition
  - Qualifications and Disqualifications
  - Powers and Functions
  - Executive
  - President
  - Governor
  - Council of Ministers
  - Judiciary, Appointment and Transfer of Judges, Qualifications
  - Powers and Functions

- Local Administration:
    - District's Administration head: Role and Importance,
    - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
    - Pachayati raj: Introduction, PRI: ZilaPachayat.
    - Elected officials and their roles, CEO ZilaPachayat: Position and role.
    - Block level: Organizational Hierarchy (Different departments),
    - Village level: Role of Elected and Appointed officials,
    - Importance of grass root democracy

- Election Commission:
    - Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners.
    - State Election Commission: Role and Functioning.
    - Institute and Bodies for the welfare of SC/ST/OBC and women

Reference Books

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

INE: 321 **DIGITAL SIGNAL PROCESSING**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

UNIT-I: Discrete – Time Signals and Linear Systems: Signals, systems, signal processing, advantages and applications of digital signal processing, Analog to digital conversion, reconstruction of analog signal, types of A/D converters, digital- to- analog converters.

UNIT-II: The Z- Transform: Definition of z-transform, z-transform and ROC of finite duration sequences, z-transform and ROC of infinite duration sequences, ROC of two sided sequences, properties of ROC, properties of z-transform, Inverse z-transform, solution of difference equations using one sided z-transform.

UNIT-III: The Discrete Fourier Transform: Discrete Fourier series, properties of Discrete Fourier series, The discrete Fourier Transform, relationship of the DFT to other transforms, properties of Discrete Fourier Transform, comparison between circular convolution and linear convolution, methods to evaluate circular convolution of two sequences, linear convolution from circular convolution.

UNIT-IV: The Fats Fourier Transforms: Introduction, direct evolution of the DFT, the fats Fourier transforms, Decimation-in-time algorithm, Decimation-in-frequency algorithms, differences and similarities between DIT and DIF algorithms, IDFT using FFT algorithms.

UNIT-V: Infinite Impulse Response Filters: Introduction, Frequency selective filters, design of digital filters from analog filters, analog low pass filter design, analog low pass Butterworth filters, analog low pass Chebyshev filters, frequency transformation in analog domain, realization of digital filters.

TEXT BOOKS

1. Digital Signal Processing : Principals, Algorithms and Applications- John G. Proakis, and Dimitris G.Manolakis, Pearson Edn.,,PHI, 2007.
2. Digital Signal Processing –Alan V. Oppenheim, Ronald W. Schaffer PHI Ed 2006

REFERENCES

1. Manson H Hayes," Digital Signal Processing," TMH Publications, 2004.
2. P.RameshBabu," Digial Signal Processing ," Scitech Publications Pvt. Ltd, Chennai

INE: 322 **PROCESS CONTROL & CONTROL COMPONENTS**

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Introduction: control systems- process control principles, servo mechanisms, discrete state control systems; Process control block diagram- identification of elements; Control system evaluation-stability, steady state regulation, transient regulation, evaluation criteria; Process control (P&I) drawings.

Controller Principles: Process characteristics: process equation, process load, process lag, self-regulation; control system parameters; Controller Modes: Discontinuous control modes- two position mode, multi-position mode; Continuous controller modes: Proportional control modes, Integral control mode, Derivative control mode, Composite control modes: PI, PD, PID; Special terminology;

Optimum controller settings: Evaluation criteria-1/4 decay ratio, I.A.E., ISE, ITAE; Tuning of controllers: Continuous oscillation and damped oscillation methods- process reaction curve method.

Multi loop control systems: Feed forward, ratio, cascade and split range controls. Multivariable control –examples from distillation column and boiler systems.

Final control elements: Flapper-Nozzle system, I/P, P/I converters, pneumatic, electric and hydraulic actuators. Globe and Butterfly valves, volume booster relays.

Control valve characteristics and sizing: Valve characteristics-quick opening, linear and equal percentage characteristics; Sizing: Flow formulae through control valves. Specific gravity and Viscosity correction, range ability, turn down ; cavitation and flashing in control valves.

References:

1. Curtis.D.Jhonson: Process control instrument Technology, Pearson education.
2. Pollard A, Process control.
3. Eckman, D.P., Automatic Process and Control.
4. Harriot,P., Process control.
5. Patrinabis,D, Principles of process control.

INE: 323 ELECTIVE – II (A) – POWER PLANT INSTRUMENTATION

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Energy sources, their availability. Introduction to Power generation- Classification: Renewable and nonrenewable energy generation resources. Renewable-wind power, solar, geothermal and bio-fuels, Nonrenewable-fossil fuels (coal, oil and natural gas) and nuclear power.

Comparison of thermal power plant, hydroelectric power plant, wind, solar, nuclear power plant on the basis of Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling.

Basic boiler operations, boiler safety standards, Combustion controls; series-parallel operation, optimizing control for air-flow- oxygen trimming control, Drum level control: feed water control, drum level control, steam flow control, two-element control, and three-element control, Furnace pressure control, steam temperature control, super heater control.

Thermal Power Plant- Method of power generation, layout and energy conversion process, major input variables, major control variables.

Turbines and governers: basic operations, turbine speed control methods. Automatic startup systems- safety systems.

TEXT BOOKS:

1. D. Patranabis: Principles of process control., TMH, New Delhi, second edition.
2. Bela.G.Liptak: Instrumentation Engineers Hand book
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.

INE: 323 ELECTIVE – II (B) – NON-DESTRUCTIVE TESTING

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Need for inspection- quality of inspection-Benefits of NDT-Liquid penetrant inspection-Principles- Characteristics of a penetrant- Water washable system post emulsifiable system-Solvent removable system- Surface preparation and cleaning- Penetrant application- Sensitivity-Viewing- Recording- Applications.

Magnetic methods; Basic principles- Magnetising methods- Characteristics of magnetic particles- Magnetic links- Magnetography- Field sensitive probes- Measurement of metal properties- Ferrography- Applications.

Ultrasonic testing: Basic principles- different kinds of ultrasonic waves- Properties propagation-Mode conversion- Construction of normal and angle probes- Piezo electric materials-attenuation. Different methods of flow detection - Transmission, reflection and immersion methods. Pulse- Echo method- Different types of display- A- Scan, B-Scan, C-Scan methods-Identification of detects- Sensitivity- calibration and reference standards- Applications.

Radiographic methods: general priciples- X-ray and gamma ray sources- Shadow formation-Enlargement and distortion recording of radiation-Radio graphic techinics- Single and double image techniques- Sensitivity- Penetramaters- Fluoroscopic method- Real time radiography-Application.

Electrical methods: Principle of eddy current testing- Conductivity of material- Magnetic properties- Coil impedance. Lift off factor and edge effect- Skiing effect- Impedance plant diagrams- inspection frequency- Coil arrangements inspection problems- Types of circuit-Reference standards- Phase analysis-Display methods- Typical applications.

Other methods: Optical holographic methods- Electronic / speckle pattern inter-formetry dynamic inspection-Neutron Radiography-Laser induced ultrasonic-Crack depth gauges-Thermography-Surface texture analysis-Acoustic emission methods.

TEXT BOOKS:

1. Non-destructive testing by Barry Hull and Vennon john ELBS/Momillon,1988,
2. Non-destructive testing by R.Halmshaw Edward Arnold, London.
3. Non destructive testing by Warren J.McgonnagleMcGraw-hill book Co., 1961.

REFERENCE BOOKS:

1. 1.Ultrasonic testing of material by J.Krantkramer and H.Krantkramer Springer Verlag, Newyork.
2. Ultrasonic Engineering by Julien r. Frederick, chapters 1,2,4,7, John wiley& son Newyork.

INE: 323 ELECTIVE – II (C) – FUNDAMENTALS OF NANO SENSORS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

NANOSENSORS I Micro and nano-sensors, Fundamentals of sensors, biosensor, micro fluids, Packaging and characterization of sensors, Method of packaging at zero level, dye level and first level. Sensors for aerospace and defense: Accelerometer, Pressure Sensor, Night Vision System, Nano tweezers, nano-cutting tools, Integration of sensor with actuators and electronic circuitry,

NANOSENSORS II Sensor for bio-medical applications: Cardiology, Neurology and as diagnostic tool, For other civil applications: metrology, bridges etc. Biosensors. Clinical Diagnostics, generation of biosensors, immobilization, characteristics, applications, conducting Polymer based sensor, DNA Biosensors, optical sensors. Biochips. Metal Insulator Semiconductor devices, molecular electronics, information storage, molecular switching, Schottky devices,

NEMS Inertial sensors – accelerometer – gyroscope - micromechanical pressure sensors – pizoresistive –capacitive - microrobotics – micro channel heat sinks – optical MEMS – visual display – precision optical platform – optical data switching – RF MEMS – MEMS variable capacitors – MEMS switches – Resonators.

NANOLITHOGRAPHY Basics of lithography, optical, micro, ion beam lithography, lithographic tools, nanoimprint lithography – polymeric nanofiber templates – focused ion beam doping wet chemical etching – stencil lithography and sacrificial etching – large scale integration – future challenges - applications

REFERENCE BOOKS:

1. K. Goser, P. Glosekotter and J. Dienstuhl, “Nanoelectronics and Nanosystems-From Transistors to Molecular Quantum Devices” , Springer, 2004.
2. W.R.Fahrner, “Nanotechnology and Nanoelectronics – Materials, Devices and Measurement Techniques” Springer, 2006.
3. Sensors: Micro &Nanosensors, Sensor Market trends (Part 1&2) by H. Meixner.
4. Nanoscience & Technology: Novel structure and phenomea by Ping Sheng (Editor).
5. Nano Engineering in Science &Technology : An introduction to the world of nano design by Michael Rieth.
6. Tai –Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill publication, 2001.
7. P. Rai-Choudhury, “MEMS and MOEMS technology and applications”, PHI learning private Ltd, 2009.
8. Mohamed Gad-el-Hak, “The MEMS Handbook”, CRC Press, 2002.

INE: 324 ELECTIVE – III (A) – ADVANCE CONTROL THEORY

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit 1:INTRODUCTION TO DESIGN
The deign problem, preliminary considerations of classical design, realization of basic compensators like phase lead compensation, phase lag compensation in time domain using root locus method

Unit 2:DESIGN OF COMPENSATORS
Cascade compensation in time domain and frequency domain, feedback compensation using both root locus and bode plot and Lead-Lag compensation using bode plot.

Unit 3: STATE VARIABLE ANALYSIS
Concept of state variables – State models for linear and time invariant Systems –Solution of state and output equation in controllable canonical form –Concepts of controllability and observability –Effect of state feedback.

Unit 4: PHASE PLANE ANALYSIS
Features of linear and non-linear systems -Common physical non-linearity's–Methods of linearization Concept of phase portraits –Singular points –Limit cycles –Construction of phase portraits –Phase plane analysis of linear and non-linear systems –Isocline method.

UNIT 5: DESCRIBING FUNCTION ANALYSIS
Basic concepts, derivation of describing functions for common non-linearities –Describing function analysis of non-linear systems –limit cycles –Stability of oscillations.

TEXT BOOKS:

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. Gopal, M. – "Modern control theory", New Age International publishers, 2002

INE: 324 ELECTIVE – III (B) – ADVANCED SENSING TECHNIQUES

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Introduction Different Phases of automation. Importance of sensor/smart sensor in automation. Features of Advanced sensing techniques. Sensor classifications according to the energy domains. Introduction of advanced sensing materials. Properties (physical, electrical, chemical, biological) of materials which makes it suitable for sensing in different domain.

Design and modelling, Design and modelling issue in advanced sensing technique, Introduction of different mathematical tools used in sensor design, Study of analytical design from given specification, conformal mapping, Optimization techniques used in sensor design. Numerical design such as FEM, FDM, etc. Study of Tomography and Concept of Feedback in sensing Fabrication and packaging Introduction to MEMS sensor. Comparison between MEMS and Macro sensor. Fabrication and packaging issue in sensor design, Thick film and thin film technique.

Physical sensors, Hall Effect sensors, Eddy current sensors, magneto resistive and magneto strictive detectors, Accelerometers: Capacitive, Piezoelectric, Piezoresistive, Thermal, Humidity and moisture sensor, Proximity detectors using polarized light, Semiconductor gas sensor, Fluidic and Micro-fluidic sensors.

Chemical sensor, Chemical sensor characteristics, specific difficulties related to chemical sensor, Classification of Chemical sensing mechanism, Study of chemical sensor based on the principle of direct sensing techniques such as Metal oxide chemical sensor, electro chemical sensors, potentiometric sensors, conductive sensors, amperometric sensors, enhanced catalytic gas sensors, enzyme sensors, Study of chemical sensors in indirect mode such as thermal sensor, optical chemical sensor, biochemical sensor, enzyme sensor, Sensor array.

Introduction to the concept of Lab on chip/senor platform technology, The role of PCA, LDA, Neural network in designing sensor array, Study of temperature cycle, mode of sensing to obtain virtual sensor array, Case study of a gas sensing platform, liquid sensing.

REFERENCE BOOKS

1. Sensors- A Comprehensive study-W.Gopal, J Hesse, J N Zemel –VHC Press, 1989.
2. Sensors Handbook-SabreeSoloman—McGraw Hill Publishers-1998
3. Electro Optical Instrumentation- SilvanoDonati, Pearson Education 2005.
4. Introduction to Medical Equipment Technology: Carr and Brown- Addison Weseley-2001.

INE: 324 ELECTIVE – III (C) – DESIGN OF INSTRUMENT SYSTEMS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Design of Pressure and vacuum gauges with bourdon tubes, bellows and diaphragms. Design of manometers-single, two liquid U-Tube manometers, inclined tube, well and ring types. Design of flow meters-orifice, venturi and Rota meters. Design of liquid level measuring instruments-displacer and bubble types. Design of control system components-flapper nozzle with ball valve, pneumatic globule valve, butterfly valve and Saunders patent valve. Design of temp measuring systems with RTD, thermocouples and thermistors. Design of displacement measuring circuits with LVDT, and differential capacitors. Design of strain gauges and measuring circuits. Design of piezoelectric transducers and measuring circuits.

REFERENCE BOOK:

1. DP Eckman-Industrial Instrumentation

INE: 325OPEN ELECTIVE- 1 HUMANITIES AND MANAGEMENT COURSE

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

INE: 411ELECTIVE – IV (A) – INSTRUMENT DATA NETWORKS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Introduction: uses of computer networks-networks for companies-networks for people.Network hardware: local area networks-network topologies-Metropolitan area networks-Wide area networks-Wireless networks

Network software: Reference models-The OSI reference model-TCP/IP reference model-comparison of models- Critiques of OSI and TCP/IP models regarding implementation and success.

Transmission media: magnetic media- twisted pair-base band coaxial cable-broadband coaxial cable-Fiber optic networks: multi mode and single mode fibers-Transmission of light through fiber-fiber cables. Fiber optic networks-comparison of fiber optics and copper wire.

Example networks and services: introduction to novellnetware, ARPANET, NSFNET, The internet-Broadband ISDN and ATM, comparison of services.

Field bus standardization, Smart transmitters- smart overview- smart mode of operation--command classes-transmission modes, Field bus-benefits of field bus-architecture- Profibus - architecture, international field bus standards

Intelligent controllers, introduction , model based controllers, adaptive controllers- optimal control-predictive control, Artificial intelligent based systems, expert systems- Expert controllers.

Fuzzy and neural controllers- Fuzzy logic system-Fuzzy logic tools, membership functions-defuzzification - fuzzy controller. Artificial neural networks-biological neuron-mathematical model-classification of ANNS- Perceptron-multilayer ANN- neural controllers, neuro-fuzzy control system.

Textbooks :

1. Computer Networks -ANDREW S. Tanandaum 3rd edition., PHI

2. Krishna kant-Computuer based industrial control, PHI

3. Instrument engineers handbook B.G. Liptak 3rd edition.

INE: 411ELECTIVE – IV (B) – DIGITAL IMAGE PROCESSING

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Digital image fundamentals:

Light and Electromagnetic spectrum, Components of Image processing system, Image formation and digitization concepts, Neighbours of pixel adjacency connectivity, regions and boundaries, Distance measures, Applications.

Image Enhancements:

Image Enhancements: In spatial domain: Basic gray level transformations, Histogram processing, Using arithmetic/Logic operations, smoothing spatial filters, Sharpening spatial filters.
In Frequency domain: Introduction to the Fourier transform and frequency domain concepts, smoothing frequency-domain filters, Sharpening frequency domain filters.

Image Restoration:

Various noise models, image restoration using spatial domain filtering, image restoration using frequency domain filtering, Estimating the degradation function, Inverse filtering.

Colour Image processing:

Colour fundamentals, Colour models, Colour transformation, Smoothing and Sharpening, Colour segmentation

Image compression:

Introduction, Image compression model, Error-free compression, Lossy compression.

Image segmentation:

Detection of discontinuities, Edge linking and boundary detection, thresholding

TEXT BOOKS

1. R. C. Gonzalez and R. E. Woods, Digital Image Processing, 3rd edition, Prentice Hall, 2008.
2. R. C. Gonzalez, R. E. Woods and Steven L. Eddins , Digital Image Processing Using MATLAB , 2rd edition, Prentice Hall, 2009.
3. Anil K.Jain, “Fundamentals of Digital Image Processing”, Prentice Hall of India, 9th Edition,
4. Jayaraman, S. Esakkirajan, and T. Veerakumar, Digital Image Processing, Tata McGraw-Hill Education, 2011.

INE: 411ELECTIVE – IV (C) – MICRO AND NANO SENSORS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit 1: Introduction sensors, Micro technology, Nano technology, Micro and nano biosensors:Introduction to Micro/Nano biosensor, Biosensor history and current status, Classical Sensors. Applications of micro electrons and nano electrons.

Unit 2: Carbon-Nanotube-Based Sensors: Introduction , Synthesis of Carbon Nanotubes, Relevant Physical Characteristics of Carbon Nanotubes, Chemical Sensors and MEMS-Based Nanotube Sensors. Carbon-Nanotube-Based Fluidic Shear-Stress Sensors:Overview of Carbon Nanotube Sensors ,Types of Shear-Stress Sensors.

Unit 3: Nanomechanical Cantilever Sensors: Theory and Applications: Introduction, Operation Principles, Preparation of Microcantilever Sensors. Protein in Films: Sensing Elements for Sensors: Protein-Containing LB Films for Biosensor Applications, Antibody-Containing LB Films, Enzyme-Containing LB Films.DNA Sensors: DNA Hybridizations, DNA sequencing, DNA-Containing Monolayers and LB Films

Unit 4: Biomolecules, Protein, DNA structures and their immobilizations on sensor surface,Thermodynamic and Kinetics at biosensor surface.Microfluidics: Advances in microfluidics, Sensor integrations. Immunosensors: antibody- antigen, Single molecule detections.

Unit 5: Optical Capillary Sensors for Intelligent Classification of Micro fluidic Samples: Introduction, Operating Principles and Construction Aspects of the Optical Capillary Head, General Description of the Sensor System, e Measurement Cycle of the Capillary Sensor. Optical biosensors: Optical Imaging, Optical Sensing, Opto-genetics.

Reference Books:

1. Nanosensors: Theory and Applications in Industry, Healthcare and Defense *Edited ByTeik-Cheng Lim (*https://www.taylorfrancis.com/books/e/9780429130793).
2. Introduction to Biosensors, Jeong-Yeol Yoon et al. *Springer*.
3. Handbook of Biosensors and Biosensor Kinetics, AjitSadana, *Elsevier*.
4. Nanofabrication Towards Biomedical Applications, Challa Kumar, *Wiley-VCH*.
5. Optical Biosensors: Present & Future, Frances Ligler, *Elsevier*

INE: 412ELECTIVE – V (A) –TELEMETRY

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Classification of Telemetry Systems:voltage, current position, frequency, pulse, land-line and radio telemetry.

Land-Line Telemetry:voltage telemetering system, current telemetering system, motion balance current telemetering system, position telemetering system using bridge configuration, position telemetering system using synchro's.

Amplitude Modulation and Demodulation of a Carrier Wave: Expression for an AM- wave, frequency spectrum of an AM-wave, bandwidth, AM-detector, illustration of AM for measuring system, full-wave phase sensitive demodulator, block diagram of carrier amplifier system.

Frequency Modulation and Demodulation of A Carrier Wave: Expression for an FM-wave, frequency spectrum of an FM-wave, bandwidth, diode FM modulator, phase shift discriminator, ratio detector.

Amplitude Modulation and Demodulation Circuitsfor Measurement Systems: Basic configuration for a modular electromechanical chopper, semiconductor modulator, balanced modulator, basic configuration of a demodulator chopper, demodulator semiconductor, demodulators, balanced demodulator. Block diagrams of DC and AC signal conditioning systems.

Multiplexing In Telemetry Systems: Block diagram of multiplexer and its mechanical switch, equivalent block diagram of a demultiplexer and its mechanical switch, equivalent frequency division multiplexing, time division multiplexing, sample-and –hold circuit, an outline of pulse modulation techniques used in telemetry.

Radio Telemetry Systems: Analog TDM system, FM-FM telemetry system, standard telemetry channel, frequencies for FDM, block diagrams of PAM, PCM, and FDM telemetry systems.

Transmission Channels: Wire line channels, radio channels, microwave channels, power line carrier channels and fiber optic transmission.

TEXT BOOKS:

1. Electrical and electronics measurements and instrumentation, by A.K.Sawhney, Dhanpat Rai & Sons .
2. Introduction to Telemetry by Alan Andrews, Foulsham-Sams technical books, published by W-Foulsham&Co Ltd., England.
3. Understanding telemetry circuits, by John D.Lenk, Foulsham – Sams technical books, Published by W.Foulsham& Co., England

INE: 412ELECTIVE – V (B) –ARTIFICIAL INTELLIGENCE

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	**1**	**--**	**4**	**3**	**70**	**30**	**100**

Basic Problem-Solving Methods: Production systems – state space search –control strategies – heuristic search – forward and backward reasoning – hill climbing techniques – breadth first search – depth first search – best search – staged search.

Knowledge Representation: Predicate logic – resolution question answering – nonmonotic reasoning – statistical and probabilistic reasoning semantic nets – conceptual dependency – frames- scripts.

AI Languages: important characteristics of AI languages- PROLOG, introduction to expert systems,structure of an expert system-interaction with an expert design of an expert system.

Neural Networks: basic structure of a neuron, perception feed forward, back propagation, Hopfield network.

Fuzzy Logic: fuzzy sets, member ship function, rules and algorithms, de-fuzzication and implementation.

Textbooks:

1. Rich E and knight K- Artificial intelligence. Tata McGraw Hill, New Delhi 1991.
2. Nillson NJ – Principals of artificial intelligence, Springer Veriag Berlin 1980.
3. Barr A.Fergenbaum E A & Cohen P R- Artificial intelligence, edition- Wesley reading (mass 0,1989).
4. Water man D A- A guide to expert systems, edition- Wesley reading (mass),1986.
5. Artificial intelligence Hand book VOL 1-2,ISA,Reasearch triangle park,1989.
6. Kos Ko B-neural networks and fuzzy systems, PHI.

INE: 412ELECTIVE – V (C) –Fiber Optics and Sensors

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Principles of light propagation through fiber- Different types of fibers and their properties– transmission characteristics of optical fibers - absorption losses-scattering losses-dispersion.

Fiber optic sensors – Fiber optic communication and instrument system – Advantages of optical communications – Different types of Modulators – Detectors – Fiber optic communication setup – Applications in instrumentation.

Characteristics and fundamentals of lasers – Laser emission and light amplification – Optical Resonators – Modes of resonators – Q-Factors , Q- Switching, Mode locking in lasers – Properties of Laser Beams - Types of lasers – Gas lasers – Solid lasers – liquid lasers – semiconductors lasers.

Lasers for Analysis – Laser application in holographic microscopy, holographic interferometer and applications -Medical applications of lasers. Laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, Brain Surgery, Plastic surgery, gynecology & oncology.

Industrial application of Lasers – Measurement of distance and length, velocity, acceleration, atmospheric effects, pollutants, Material processing, laser heating, melting, scribing, splicing, material removal.

REFERENCE BOOKS

1. H.C. Allen, An Introduction to Optical Fibers, McGraw-Hill International Book Co., 1983.
2. John and Harry, Industrial lasers and their applications, McGraw Hill publications,1974
3. Gerd Kaiser, Optical fiber communications, McGraw Hill International Edition,2000
4. D.C. Oshea and W.Russel Callen, Introduction to lasers and their Applications, Addison Wesley, 1978.
5. BS. Wherrelt, Laser Advances and Applications, John Wiley, 1979.
6. W.O.N. Guimarass and A.Mooradian, Lasers and Application Springer Verlag, 1981.

INE: 413 OPEN ELECTIVE – 2 - IoT Sensors and Devices

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

IoT Platform overview
Overview of IoT supported Hardware platforms such as: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

IoT Architecture:
History of IoT, M2M – Machine to Machine, Web of Things, IoT protocols
Applications: Remote Monitoring & Sensing, Remote Controlling, Performance Analysis
The Architecture: The Layering concepts, IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN
Security aspects in IoT

Case Study & advanced IoT Applications:
IoT applications in home, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipment. Use of Big Data and Visualization in IoT, Industry 4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi / Intel Galileo/ARM Cortex/ Arduino)

Text Books:

1. Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, Dr. OvidiuVermesan, Dr. Peter Friess, River Publishers.
2. Interconnecting Smart Objects with IP: The Next Internet, Jean-Philippe Vasseur, Adam Dunkels, Morgan Kuffmann.
3. 6LoWPAN: The Wireless Embedded Internet, Zach Shelby, Carsten Bormann, Wiley.

INE: 414 BIOMEDICAL INSTRUMENTATION

L	T	PD	TOTAL Pds	Univ Exam		Sessnl Marks	Total Marks
				Hrs	Marks		
3	1	--	4	3	70	30	100

Introduction to the Man-Instrument system – components of the system – Problems encountered in measuring a living system — sources of bioelectric potentials – Structure of a cell- resting and action potentials.

The cardiovascular system – The heart anatomy – Generation of Electrocardiogram – Recording ECG - Blood pressure measurement- Direct and Indirect methods - Sphygmomanometer – Blood flow measurement – heart sounds – Phono Cardiograph – measurement of blood flow and cardiac output - plethysmography– pacemakers – defibrillators.

Physiology of the respiratory system – tests and instrumentation for the mechanics of the breathing – Spirometers- respiratory therapy inhalators – ventilators-humidifiers nebulizers and aspirators.

The nervous system and its anatomy – neuronal communication – the organization of brain – neuronal receptors – the somatic nervous system – the autonomic nervous system – measurements from the nervous system – electrode placement-neuronal firing measurements EEG and EMG.

Noninvasive diagnostic instrumentation - temperature measurement – principles of ultra sound measurement and diagnosis – echo cardiogram – echo encephalogram – ultra sonogram. X-ray machine- CT Scan- MRI Scan- Computer in biomedical instrumentation. Physiological effects of electric current – shock hazards from electric equipment – methods of accident prevention.

TEXT BOOKS:

1. Biomedical Instrumentation and Measurements – C. Cromwell, F.J. Weibell, E.A. Pfeiffer – Pearson education.
2. Handbook of biomedical instrumentation R. S. Khandpur, Tata McGraw hill company Ltd, New Delhi.

INE: 421 ELECTIVE – IV (A) – STEEL PLANT INSTRUMENTATION

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Basics of steel production; mill zones: iron zone, steel zone, mill zone, utility zone Automation strategy: different levels, input, output data. Iron zone: supervisory control, direct digital control; instrumentation for-raw material handling, coke oven, sinter plant, Blast furnace; input/output data, control architecture. Steel zone: Automation for- LD converters, continuous casting, soaking pit control, blooming mill controls.

Utility zone: instrumentation for-Gas distribution, liquid fuel distribution, power generation, steam generation, compressed air generation.

Instrumentation for water management system.

Pollution control and monitoring for steel plant environment.

TEXT BOOKS:

1. D. Patranabis: Principles of process control., TMH, New Delhi, second edition.
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.

REFERENCE BOOKS:

1. Bela.G.Liptak: Instrumentation Engineers Hand book

INE: 421 ELECTIVE – IV (B) – INDUSTRIAL SAFETY INSTRUMENTS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Safety In Metal Working Machinery And Wood Working Machines General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines, Wood working machinery, types, safety principles, electrical guards, work area, material handling, inspection, standards and codes- saws, types, hazards.

Principles Of Machine Guarding Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling-grinding-shaping-sawingshearingpresses- forge hammer-flywheels-shafts-couplings-gears-sprockets wheels and chains-pulleys and belts-authorized entry to hazardous installations-benefits of good guarding systems.

Safety In Welding And Gas Cutting Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – explosive welding, selection, care and maintenance of the associated equipment and instruments – safety in generation, distribution and handling of industrial gases-colour coding – flashback arrestor – leak detection-pipe line safety-storage and handling of gas cylinders.

Safety In Cold Forming And Hot Working Of Metals Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls, power press set up and die removal, inspection and maintenance-metal sheers-press brakes. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills – hot bending of pipes, hazards and control measures. Safety in gas furnace operation, cupola, crucibles, ovens, foundry health hazards, work environment, material handling in foundries, foundry production cleaning and finishing foundry processes.

Safety In Finishing, Inspection And Testing Heat treatment operations, electro plating, paint shops, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing, valves, boiler drums and headers, pressure vessels, air leak test, steam testing, safety in radiography, personal monitoring devices, radiation hazards, engineering and administrative controls, Indian Boilers Regulation.

REFERENCE BOOKS:

1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.

3. “Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
4. “Safety in Industry” N.V. Krishnan JaicoPublishery House, 1996.
5. Indian Boiler acts and Regulations, Government of India.
6. Safety in the use of wood working machines, HMSO, UK 1992.
7. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

INE: 421 ELECTIVE – IV (C) – ROBOTS & COMPUTER CONTROL OF MACHINE PARTS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit- I Robot anatomy: Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot Classifications-Architecture of robotic systems-

Unit- II Introduction to automation: Components and subsystems, basic building block of automation, manipulator arms, wrists and end-effectors. Transmission elements: Hydraulic, pneumatic and electric drives. Gears, sensors, materials, user interface, implications for robot design, controllers.

Unit- III Machine Vision: Introduction, Low level &High-level vision, Sensing &Digitizing, Image processing & analysis, Segmentation, Edge detection, Object description & recognition, Interpretation, Applications

Unit- IV Kinematics, dynamics and control: Object location, three-dimensional transformation matrices, inverse transformation, kinematics and path planning, Jacobian work envelope, manipulator dynamics, dynamic stabilization, position control and force control, present industrial robot control schemes.

Unit- V Robot programming: Robot programming languages and systems, levels of programming robots, problems peculiar to robot programming, control of industrial robots using PLCs.

Unit- VI Automation and robots: Case studies, multiple robots, machine interface, robots in manufacturing and non-manufacturing applications, robot cell design, selection of a robot.

REFERENCE BOOKS:

1. S.R. Deb, Robotics Technology and flexible automation, Tata McGraw-Hill Education., 2009
2. Mikell P Groover & Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, McGraw Hill, 2012.
3. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, Robotics Engineering an Integrated Approach, Phi Learning., 2009.
4. Francis N. Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1987.
5. P.A. Janaki Raman, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing company Ltd., 1995.

6. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008.
7. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
8. Craig. J. J. “Introduction to Robotics mechanics and control”, Addison- Wesley, 1999. 9. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985.

INE: 422 OPEN ELECTIVE – III – PROGRAMMABLE CONTROL SYSTEMS

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

Unit- IControl Systems and Automation Strategy
Evolution of instrumentation and control, Role of automation in industries, Benefits of automation, Introduction to Descriptive automation tools PLC, DCS, SCADA, Hybrid DCS/PLC, Automation strategy evolution, Control system audit, and performance criteria.

Unit- IIInstrumentation Standard Protocols
Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation.
Foundation Fieldbus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.

Unit- IIIProgrammable logic controllers (PLC)
Introduction, architecture, definition of discrete state process control, PLC Vs PC, PLC Vs DCS, relay diagram, ladder diagram, ladder diagram examples, relay sequencers, timers/counters, high speed counter, PTO, PWM and PID blocks in PLC, PLC design, study of at least one industrial PLC.

Unit- IVAdvance Applications of PLC and SCADA
PLC programming methods as per IEC 61131, PLC applications for batch process using SFC, Analog Control using PLC, PLC interface to SCADA/DCS using communication links (RS232, RS485) and protocols (Modbus ASCII/RTU)

Unit- VDistributed Control Systems
DCS introduction, functions, advantages and limitations, DCS as an automation tool to support Enterprise Resources Planning, DCS Architecture of different makes, specifications, configuration and programming, functions including database management, reporting, alarm management, communication, third party interface, control, display etc. Enhanced functions viz. Advance Process Control, Batch application, Historical Data Management, OPC supports, Security and Access Control etc.

Reference:

1. Distributed Computer Control for Industrial Automation, PoppovikBhatkar, Dekkar Publications
2. Programmable Logic Controllers: Principles and Applications, Webb and Reis, PHI.

3. Computer Aided Process Control, S. K. Singh, PHI.
4. Introduction to Programmable Logic Controllers, Garry Dunning, Thomson Learning.
5. Computer Based Process Control, Krishna Kant, PHI.
6. The Management of Control System: Justification and Technical Auditing, N. E. Battikha, ISA.

INE: 423 OPEN ELECTIVE – IV – VLSI

L	T	PD	TOTAL Pds	Univ Exam Hrs	Univ Exam Marks	Sessnl Marks	Total Marks
3	1	--	4	3	70	30	100

INTRODUCTION TO MOS TECHNOLOGY:
Various types of technologies – Bi-polar, MOS, CMOS, NMOS, PMOS. Comparison, fabrication of NMOS, PMOS, CMOS, BiCMOS devices. Basic Electrical Properties: Drain-to-source current versus Voltage relationship, Threshold voltage, MOS transistor transconductance and output conductance, figure of merit, Pass transistor, determination of Pull-up to Pull-down ratio of NMOS Inverter driven by another Inverter, determination of Pull-up to Pull-down ratio of NMOS Inverter driven through one or more Pass transistors.

CIRCUIT DESIGN PROCESSES:
NMOS circuits: Inverter, NAND and NOR gates, CMOS circuits: Inverter, NAND and NOR gates. Stick Diagrams: NMOS Design style and CMOS Design Style. Design rules: Lambda based design rules, contact cuts, CMOS Lambda based design rules, Layout diagrams: NMOS Inverter, NAND and NOR gates, CMOS Inverter, NAND and NOR gates. Inverter delays, propagation delays.

INTEGRATED CIRCUIT DESIGN:
Types of ASICs: full custom and semi-custom devices, Major activities in ASIC Design, ASIC Design and Development flow, Standard Cell based ASICs, Gate arrays based ASICs including channeled, sea-of gates, structured gate arrays. PLDs: Block diagram of PLA, PLA design, Bipolar PLA, NMOS PLA, PLA organization, folded PLA, CPLD, PAL design,
FPGA block diagram, CLB, interconnect, I/O blocks

VLSI DESIGN TOOLS:
VHDL synthesis, VHDL synthesizer, Circuit design flow, Circuit Synthesis, Simulation, types of Simulations, Simulation versus Synthesis, Design verification tools, Test vector generation, Scan based techniques, Boundary scan test, BIST.

PACKAGING:
Types of packages, VLSI design rules, Constraints: Electrical, Mechanical, Thermal design considerations of IC packages.

REFERENCE BOOKS:

1) Basic VLSI Design by Douglass 3rd Edition, A Pucknell and Kamran Eshraghian, PHI,1994.
2) Applications specific integrated Circuits by Michel John Sebastian Smith, Addison Wesley, 1997.
3) Introduction of VLSI by Mead and Convay.