Appendix " V " Item No. 40

**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 Hrs per week Allotment of Marks Total Ext.Exam C

 L T P Ses. Ext. Marks Time

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 Hrs per week Allotment of Marks Total Ext.Exam C

 L T P Ses. Ext. Marks Time

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

**ENG1206: Basic Electronics and Digital Systems.**

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

Code Number Course Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 Managerial Economics 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 Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 - 1Industrial Management and Entrepreneurship.

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

Code Number Course Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 Hrs per week University Examination. C

 L T P Total Ses. Ext. Marks Time hours. Marks Marks

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 Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Total

 Hrs Marks Marks 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 : MANAGERIAL ECONOMICS**

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks Marks

 **3 1 — 4 3 70 30 100**

Unit -I - Significance of Economics and Managerial Economics Economics: Definitions of Economics- Wealth, Welfare and Scarcity definition Classification of Economics- Micro and Micro Economics.

Managerial Economics: Definition, Nature and Scope of Managerial Economics, Differences between Economics and Managerial Economics, Main areas of Managerial Economics, Managerial Economics with other disciplines.

Demand Analysis :Demand - Definition, Meaning, Nature and types of demand, Demand function, Law of demand - Assumptions and limitations. Exceptional demand curve.

Elasticity of demand - Definition, Measurement of elasticity, Types of Elasticity ( Price, Income, Cross and Advertisement), Practical importance of Price elasticity of demand, Role of income elasticity in business decisions, Factors governing Price Elasticity of demand.

Demand Forecasting - Need for Demand forecasting, Factors governing demand forecasting, Methods of demand forecasting: Survey methods- Experts’ opinion survey method and consumers Survey methods.

Utility Analysis: Utility- Meaning, Types of Economic Utilities, Cardinal and Ordinal Utility, Total Utility, Marginal Utility, The law of Diminishing Marginal Utility and its Limitations.

Unit -II - Theory of Production and Cost analysis : Production - Meaning, Production function and its assumptions, use of production function in decision making; Law of Variable Proportions: three stages of the law.

Cost analysis - Nature of cost, Classification of costs - Fixed vs. Variable costs, Marginal cost, Controllable vs. Non - Controllable costs, Opportunity cost, Incremental vs. Sunk costs, Explicit vs. Implicit costs, Replacement costs, Historical costs, Urgent vs. Postponable costs, Escapable vs. unavoidable costs, Economies and Diseconomies of scale.

Unit -IIIMarket Structures : Definition of Market, Classification of markets; Salient features or conditions of different markets - Perfect Competition, Monopoly, Duopoly , Oligopoly, Importance of kinked demand curve ;Monopolistic Competition.

Unit -IVPricing Analysis : Pricing - Significance: Different Pricing methods- Cost plus pricing, Target pricing, Marginal cost pricing, Going -rate pricing, Average cost pricing, Peak load pricing , Pricing of joint Products, Pricing over the life cycle of a Product, Skimming pricing Penetration pricing, Mark- up and Mark- down pricing of retailers.

Unit -VBusiness cycles, Inflation and Deflation : Business cycles - Definition , Characteristics , Phases, Causes and Consequences; Measures to solve problems arising from Business cycles.

Inflation -Meaning, Types, Demand- pull and Cost push inflation, Effects of Inflation, Anti- inflationary measures.

Deflation- Meaning, Effects of Deflation, Control of Deflation, Choice between Inflation and Deflation.

*Text Books:*

1. Sankaran,S., Managerial Economics,Marghan Publications, 2015, Chennai.

2. Aryasri, A.R., Managerial Economics and Financial Analysis, MC Graw Hill Education, New Delhi,2015.

*Reference Books:*

1. Dwivedi, D.N., Managerial Economics,Vikhas Publishing House Pvt. Ltd. 6th Edition, New Delhi,2004.

2. Dewett, K.K., **Modern Economic Theory**, S.Chand& Company Ltd., New Delhi, 2005.

**INE: 221 : ENVIRONMENTAL SCIENCE AND ENGINEERING**

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 ù0), 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 sensorarray,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 Sessnl Total

 Hrs Marks Marks 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: 325 OPEN ELECTIVE- 1**

**Industrial Management and Entrepreneurship**

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks Marks

 **3 1 — 4 3 70 30 100**

Unit-I - Basic Concepts of Management : Management: - Definition, Nature and Importance; Functions of the Management; Levels of Management; F.W Taylor’s Scientific Management; Henry Fayol’s Principles of Management;

Unit-II - Forms of Business Organizations : Introduction, Types of Business organizations: Private Sector- Individual Ownership, Partnership, Joint stock companies and Co-Operative organizations; Public sector- Departmental Organizations, Public Corporations and Government Companies; The Joint sector Management.

Unit-III- Production and operations Management : Plant location- Factors to be considered in the selection of Plant location; Break - even analysis- Significance and managerial applications; Importance of Production Planning and Control and its Functions; Human Resource Management and Functions of Human Resource Manager (in brief); Functions of Marketing; Methods of Raising Finance.

Unit-IVEntrepreneurship : Definition, Characteristics and Skills, Types of Entrepreneurs, Entrepreneur vs. Professional Managers, Growth of Entrepreneurs, Nature and Importance of Entrepreneurs, Women Entrepreneurs, Problems of Entrepreneurship.

Unit-V - Entrepreneurial Development and Project Management : Institutions in aid of Entrepreneurship Development, Idea generation: Sources and Techniques;, Stages in Project formulation ; Steps for starting a small enterprise - Incentives for Small Scale Industries by Government.

*Text Books:*

(1 )Sharma,S.C, and Banga, T.R., Industrial Organization & Engineering Economics, Khanna Publishers, Delhi, 2000.

(2) Vasant Desai ,The Dynamics of Entrepreneurial Development and Management (Planning for future Sustainable growth),HImalayan Publishing House, 2018.

*Reference Books:*

 (1) Aryasri , A.R., Management Science, McGraw HIll Education (India Private Limited , New Delhi 2014.

(2) Sheela, P. , and Jagadeswara Rao, K., Entrepreneurship, Shree Publishing House, Guntur, Andhra Pradesh, 2017.

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

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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: 413OPEN ELECTIVE – 2 - IoT Sensors and Devices**

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks 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 Total

 Hrs Marks Marks 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 companyLtd, New Delhi.

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

 L T PD TOTAL Pds Univ Exam Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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 Sessnl Total

 Hrs Marks Marks 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.

**M.Tech (Instrumentation and Control), Two Year
(Four Semesters)**

Scheme to be valid with effect from the admitted batch of 2019 – 2020

**SEMESTER-I**

 Code Name of the Subject Periods/Week Max. Marks Total Credits

 Theory Lab Ext. Int.

MTIE-1.1 Advanced Transducers and
 Measurement Technique 3 - 70 30 100 3

MTIE-1.2 Digital Signal Processing 3 - 70 30 100 3

MTIE-1.3 Elective IAdvanced Process Control /
 Analytical Instrumentation / Computer
 Control of Process 3 - 70 30 100 3

MTIE-1.4 Elective IIBio-Medical Instrumentation /
 Electronic Instrumentation /
 Digital Instrumentation 3 - 70 30 100 3

MTIE-1.5 Research Methodology & IPR 3 - 70 30 100 2

MTIE-1.6 Audit Course 3 - 70 30 100 0

MTIE-1.7 Industrial Instrumentation Lab - 3 - 100 100 2

MTIE-1.8 Microprocessors Lab - 3 - 100 100 2

 Total 18 06 420 380 800 18

**SEMESTER-II**

 Code Name of the Subject Periods/Week Max. Marks Total Credits

 Theory Lab Ext. Int.

MTIE-2.1 Microcontrollers and Embedded
 Systems 3 - 70 30 100 3

MTIE-2.2 Virtual Instrumentation 3 - 70 30 100 3

MTIE-2.3 Elective – IIIa) Industrial
 Communication Systems
 b) Robotics and Automation
 c)Power Plant Instrumentation - 70 30 100 3

MTIE-2.4 Elective – IVa) Advanced Sensors
 b) Piping and Instrumentation
 c) Steel Plant Instrumentation 3 - 70 30 100 3

MTIE-2.5 Audit Course 3 - 70 30 100 0

MTIE-2.6 Process Control Lab - 3 - 100 100 2

MTIE-2.7 Virtual Instrumentation Lab - 3 - 100 100 2

MTIE-2.8 Mini Project With Seminar - 3 - 100 100 2

 Total 15 9 350 450 800 18

**SEMESTER-III**

 Code Name of the Subject Periods/Week Max. Marks Total Credits

 Theory Lab Ext. Int.

MTIE-3.1 Elective Va) Fiber Optics and Laser
 Instrumentation b) Fuzzy Logic and
 Neural Networks and Control /
 Environmental Analysis
 Instrumentation 3 - 70 30 100 3

MTIE-3.2 Open ElectiveVLSI Design 3 - 70 30 100 3

MTIE-3.3 Dissertation- I / Industrial Project - - - 100 100 10

 Total 6 140 160 300 16

**SEMESTER-IV**

 Code Name of the Subject Periods/Week Max. Marks Total Credits

 Theory Lab Ext. Int.

MTIE-4.1 Dissertation- II - - 70 30 100 16

 Total 70 30 100 16

Note:

1. At the end of 3rd semester project review is conducted by HOD with the committee consisting of the HOD, Chair Person of BOS and the Guide. In the Affiliated Colleges, Project (Preliminary) will be evaluated by concerned HOD and the thesis Guide of their respective colleges.

2. At the end of the 4th semester there will be a final viva voce for the project work conducted by the HOD with the committee consisting of HOD, Chair Person of BOS, the Guide and an External examiner nominated by the university.

Audit Course 1 & 2

1. English for Research Paper Writing

2. Disaster Management

3. Sanskrit for Technical Knowledge

4. Value Education

5. Constitution of India

6. Pedagogy Studies

7. Stress Management by Yoga

8. Personality Development through Life Enlightenment Skills.

**MTIE-1.1Advanced Transducers and Measurement Technique**

Transducer fundamentals, Classification of transducers, General transducer characteristics, Resistance- Capacitance, Inductance- reluctance- Piezoelectric Magnetostrictive- Hall effect- Photo electric type of transducers and their applications. Smart Transducers- Transducers for Bio-Medical applications- tactile sensors-MEMS and their applications. Measurement ofForce, Acceleration, Strain and Torque. Design of Electrical, Optical, & MEMS Accelerometers. Design of Gyroscopes.

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.

*REFERENCE BOOKS*

1. Patranabis.D., “Principles of Industrial Instrumentation,” McGraw-Hill PublishingCompany, 1984.

2. D. V.S.Murthy, Transducers in instrumentation, Prentice Hall, 1995.

3. Ernest. O. E. Doebelin, “Measurement Systems”, McGraw-Hill publishing company, 1990.

4. James.W.Dally, “Instrumentation for Engineering Measurement”, John Wiley &Sons, Inc., 1993.

5. Bela G. Liptak, Process measurement and Analysis-Instrument Engineers’ Handbook- Vol. I Third edition- Butterworth Heinemann publishing company

**MTIE-1.2 : Digital Signal Processing**

Linear Shift Invariant Systems : Signals, systems and signal processing, discrete time signals, discrete time systems, analysis of linear time invariant systems, classification of discrete time systems, block diagram and signal flow graphs, structures for realization for IIR systems, structures for realization of FIR systems.

Discrete Fourier Transforms : Introduction, Circular shift and circular symmetries of a sequence, properties of DFT, linear convolution, circular convolution, performing linear convolution using DFT, sectioned convolution, Fast Fourier Transforms, Decimation – in time FFT, Decimation –in- frequency FFT, computation of IDFT through FFT.

FIR Filters : LTI systems as frequency selective filters, FIR filters, characteristics of FIR filters with linear phase, frequency response of linear phase FIR filters, Design techniques for linear phase FIR filters, Fourier series method of FIR filter design, windows, FIR filter design using windows, Design of FIR filters by frequency sampling technique.

IIR Filters : Introduction, Impulse Invariant transformation, Bilinear Transformation, specifications of the low pass filter, design of low pass digital Butterworth filter, Design ofloa pass digital Chebyshev filter, Frequency transformation.

Finite Word Length Effects in Digital Filters : Introduction, representation of numbers in Digital system, Types of arithmetic in digital systems, quantization by truncation and rounding, quantization of input data, quantization of filter coefficients, product quantization error, limit cycles in recursive systems.

Text Books : 1. John G Proakis,” Digital Signal Processing: Principles, Algorithms and Applications,” Pearson Education, 4th Edition 2007.

2. Alan V Openhiem, Ronald W Schafer , “Digital Signal Processing,” PHI learning Pvt. Ltd, 1975

*References*

1. Manson H Hayes,” Digital Signal Processing,” TMH Publications, 2004.

2. P.RameshBabu,” Digital Signal Processing ,” Scitech Publications.

**MTIE-1.3Elective I (A) Advanced Process Control**

Review of systems: Review of first and higher order systems, closed and open loop response. Response to step, impulse and sinusoidal disturbances.

Design aspects: Process characteristics-process equation, process load, process lag, self-regulation; Control system parameters- Error, variable range, Control parameter range, control lag, dead time, cycling.

Control valve types-linear, equal percentage and quick operating valves. Flow equation through valves-viscosity correction, rangeability, turn down, cavitation and flashing of valves, Design of valves.

Optimum controller settings: evaluation criteria-1/4 decay ratio, IAE, ISE,ITAE; Controller tuning and process identification—open loop and closed loop tuning methods—Ziegler-Nichols and Cohen –coon tuning methods.

Special control techniques: Advanced control techniques, cascade, ratio, feed forward, adaptive control, selective controls, smith predictor, internal model control. Multivariable control – examples of distillation column and boiler control systems.

Intelligent control: Model based controllers- adaptive controller-model reference adaptive control-self tuning regulator -adaptive controllers-optimal control-predictive control

 Expert systems- expert controller-Fuzzy logic systems-fuzzy controller-Fuzzy logic tools-Artificial neural networks-perceptron-neural controllers.

*Reference Books*

1. D.R.Coughnour,’Process Systems analysis and Control’, McGraw Hill,II Edition, 1991.

2. Curtis.D.Jhonson: Process control instrument Technology, Pearson education**.**

3. D.E.Seborg,T.F.Edger and D.A.MillixhMP, ‘Process Dynamics and control’, Hohn Wiley and Sons, II Edition, 2004

4. C.A.Smith and A.B.Corripio,’Principle and Practice of Automatic Process Control’ John Wiley and Sons, 1985

5. W.L.Luyben, ‘Process Modelling simulation and Control for Chemical Engineers’, McGraw Hill, II Edition,1990

6. Stephanopoulos., ‘Chemical Process Control-Theory and Practice’, Prentice Hall of India Ltc., 1984.

7. Krishna Kant., ‘Computer based Industrial Control’, Prentice Hall of India Pvt., Ltd., 2002

**MTIE-1.3 Elective I (B) Analytical Instrumentation**

Design, construction and application of UV, Visible and IR spectroscopy, X-ray absorption and fluorescence spectrometry- X-ray diffraction methods of analysis – energy dispersion analysis –– Radiation sources - á, â, ã, sources – detectors –Geiger Mueller counter – proportional counters – Ionization chamber, scintillation counter and Solid-State Detectors.

Nuclear Magnetic Resonance (NMR) spectroscopy – Principles of operation and constructional details of NMR spectrophotometer – Broad band spectrometer – Applications. Principles andapplications of Electron Spin Resonance (ESR) spectrometer. Mass spectrometry – principle of operation – Co-analyzer – Commercial mass spectrometer.

Flue Gas and Water Analyzers: Flue gas analysis is using thermal conductivity principle – Cathetometer – Oxygen analyzer using paramagnetic, depolarization principles – Zirconium oxide cells – COX,SOX, NOX Measurement-combustibles analyzer – Different types of Dust and Smoke meters – Visible Emission Monitor – Remote sensing laser instruments

Water purity meter – Conductivity meters – Steam purity measurement – Dissolved oxygen meter using polarographic principle – Sodium analyzer – Silica analyzer.

Gas Chromatography: Basic Principle and construction –Different types of columns – Detectors – Recorders and associated equipment. Industrial and laboratory applications of gas Chromatography.

Liquid Chromatography: Salient features of liquid chromatography Ionizing electrodes - pH and ion sensitive electrodes, ISFET and chemical sensors. Applications of high precision liquid chromatography. Current trends in analysis instrumentation.

*Reference Books*

1. D.A. Skoog and D.M. West, Principles of Instrumental Analysis, Holt Saunders’s publication, Philadelphian, 1980.

2. C.K. Mann, T.J. Vichers and W.H. Gulick, Instrumental Analysis, Harper and Row Publishers, New York, 1974.

3. H.A. Willard, L LMerrit and J.A. Dean, Instrumental Method of Analysis D. Van Nostrand Co., New York, 1958.

4. E.B.Jones, Instrument Technology, Vol.II, Instruments, Butterworth Scientific Pub., London, 1956.

5. B.G. Liptak, Instrumentation in Process Industries Suppl. To Vol.I& III Chilton Book Co., 1974.

**MTIE-1.3 Elective I (C) Computer Control of Process**

Introduction: objective of automation-basic functions- Historical developments of control systems-current trends in computer control of process plants-centralized-distributed and hierarchical control systems-intelligent control.

Supervisory control and data acquisition systems: -channel scanning-conversion to engineering units-Data Processing-Distributed SCADA system-Remote terminal UJIT-communication module- special software facilities

Direct Digital control:DDC structure- DDC software-position algorithm-velocity algorithm-position vs. velocity algorithm- cascade control-ratio control-multivariable control

Programmable controllers:advantages-principles of operation-architecture of programmable controllers-input/output system-programming devices.

Programming of PLCs: ladder diagrams-special functions-data transfer and data manipulation operations-arithmetic operations-flow control operations.Boolean mnemonics-functional blocks-English like statement-applications.

Distributed Digital Control: introduction-distributed vs. centralized-advantages of distributed control-Functional requirements of DCS-System architecture-distributed control sub systems-local field station-library of functions-continuous process displays-atch/sequence operating displays-process upset displays- communication options in distributed control systems- configuration- some popular distributed control systems.

Modeling and simulation for plant automation: definitions-need of modeling-uses- model building-model evaluation-applications and future perspectives

*Reference Books*

1. Krishna kant-Computuer based industrial control, PHI

2. Instrument engineer’s handbook B.G. Liptak 3rd edition.

3. Curtis.D.Johnson: Process control instrumentation technology

4. Patrinabis,D, Principles of process control.

**MTIE-1.4 Elective II (A) Bio-Medical Instrumentation**

Basic Concepts of Bio-Medical Instrumentation: Terminology – Generalized medical instrumentation system – Measurement constrains – Classification – Interfacing and modifying inputs – Bio statistics – Static and dynamic characteristic – Regulation of medical devices – Electrical safety in medical environment.

Basic Sensors and Signal Processing: Displacement measurements – Resistive sensors – Bridge circuits – Inductance, capacitance and piezo electric sensor – Temperature measurements – Thermocouples – Radiation thermometry – Fiber optic temperature sensors – Optical measurements – Op-amp circuits – Phase sensitive demodulation – Oscillographic, galvanometric and potentiometric recorders – Microcomputers in bio medical instrumentation.

Bio-potentials and Measurements: Electric activity and excitable cells – Functional organization of peripheral nervous system. ENG, EMG, ECG, EEG & MEG – Bio-potential electrodes – Electrolyte interface. Polarization – Body surface recording electrodes – Electrodes for electric simulation of tissues – Practical hints for using electrodes – Bio potential amplifiers.

Blood pressure, Flow and Sound Measurement: Direct and indirect blood pressure measurement and analysis – Bandwidth requirement – Typical waveforms – Phonocardiography – Electromagnetic and ultrasonic flow meters – Photo plethysmography.

Clinical Measurement and Imaging Systems: Respiratory instruments – Transducers, Spiro meters, pulmonary measurements and instruments – Oxymeter – Laser application in medicines – Pulsed ruby, NdYag, Argon and Carbon-dioxide lasers – X-ray machines – Fluoroscopic machines, thermogram equipments – Ultrasonic imaging – Scanning methods and applications – Image evaluation and processing in medical field – Artificial assist devices.

*REFERENCE BOOKS*

1. Khandpur R.S., “Handbook of Bio-medical Instrumentation”, Tata McGraw-HillPublication Company, 1989.

2. Dean D.E. Marre A., “Bio electronic Measurements”, Prentice Hall, 1983.

3. All Evans, “The Evaluation of Medical Images, “Adam Hilger publication, 1981.

4. John G.Webster, “Medical Instrumentation application and design”, John Wileyand Sons, 1999.

5. Cromwell. L.FredJ.Webbell, “Bio medical Instrumentation and measurements”, Prentice Hall, 1995.

**MTIE-1.4 Elective II(B) Electronic Instrumentation**

ANALOG INSTRUMENTATION: Electronic voltmeters VTVM, TVM, FETVM Voltmeters, electronic – multimeters differential voltmeters.

CATHODE RAY OSCILLOSCOPE: Block diagram vertical and horizontal amplifiers, sweep circuits delay line, dual trace oscilloscopes. Q-meters, vector – voltmeters, instruments for generating and analyzing wave forms, square wave, pulse, standard-signal, random noise and function generators wave analysers spectrum analysers, wave-meters.

DIGITAL INSTRUMETNS: Digital voltmeters, digital frequency meters, digital display method and units, digital read out oscilloscopes, data acquisition system.

*REFERENCE 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 measurements and instrumentation by Rajendra Prasad.

**MTIE-1.4 Elective II(C) Digital Instrumentation**

Introduction: Digital codes – Memory devices – Basic building blocks – Gates, FF and counters – Discrete data handling – Sampling – Sampling theorem – Aliasing errors – Reconstruction – Extrapolation – Synchronous and asynchronous sampling.

Digital methods of measurements Review of A/D, D/A techniques – F/V and V/F conversion techniques – Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling – Sources of error – Noise – Inherent error in digital meters, hidden errors in conventional ac measurements – RMS detector in digital multimeters – Mathematical aspects of RMS.

Digital display & recording devices: Digital storage oscilloscopes – Digital printers and plotters – CDROMS – Digital magnetic tapes, dot matrix and LCD display CROs, colour monitor, digital signal analyzer and digital data acquisition.

Current trends in digital instrumentation: Introduction to special function add on cards – Resistance card – Input and output cards – Counter, test and time of card and digital equipment construction with modular designing; interfacing to microprocessor, micro controllers and computers - Computer aided software engineering tools (CASE) – Use of CASE tools in design and development of automated measuring systems – Interfacing IEEE cards – Intelligent and programmable instruments using computers.

*REFERENCE BOOKS*

4. Digital Instrumentation: Bouwens, A.J., McGraw Hill, 1984.

5. Handbook ofMicro computer based Instrumentation and Control John Lenk, D., PHI, 1984.

6. Measurement System, Application & Design: Doebelin, IV Ed, McGraw-Hill, 1990.

7. ‘Product catalogue’, Hewlett Packard, 1996.

**MTIE-1.5 Research Methodology & IPR**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.

Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.

Traditional knowledge Case Studies, IPR and IITs.

*REFERENCE BOOKS*

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”

3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”

4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.

5. Mayall, “Industrial Design”, McGraw Hill, 1992.

6. Niebel, “Product Design”, McGraw Hill, 1974.

7. Asimov, “Introduction to Design”, Prentice Hall, 1962.

8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.

9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

**MTIE-1.6 Audit Course**

**MTIE-2.1 Microcontrollers and Embedded Systems**

Architecture of 8/16 bit microcontrollers**:**8748 micro controller architecture: program memory – data memory – I/O ports – BUS Ports, Test and interrupt inputs- instruction set and programming.

8051 Microcontroller family - architecture, parallel and serial I/O - instruction set – programming and hardware interfacing techniques

8096 Microcontroller – CPU, RAM space, memory space, high speed input & outputs, analog inputs - serial I/O ports - parallel I/O ports and watch dog timer.

The concept of embedded systems design.  Embedded microcontroller cores, embedded memories. Examples of embedded systems.

 Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing. Sub-system interfacing, interfacing with external systems, user interfacing.

 Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

*Texts/References*

1. J.W. Valvano, “Embedded Microcomputer System: Real Time Interfacing”, Brooks/Cole, 2000.

2. Jack Ganssle, “The Art of Designing Embedded Systems”, Newnes, 1999.

3. David Simon, “An Embedded Software Primer”, Addison Wesley, 2000.

4. K.J. Ayala, “The 8051 Microcontroller: Architecture, Programming, and Applications”, Penram Intl, 1996.

5. B.P.Singh ., Microprocessors and Microcontrollers-Golgotia publications-2003

**MTIE-2.2 Virtual Instrumentation**

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.

**Introduction to LabVIEW :** Introduction, Advantages of LabVIEW, software Environment, Front panel, Block diagram, Data flow programming.

Programming Concepts of Virtual Instrumentation : VI & sub VI, loops, shift registers, feedback node, formula node, case and sequence structures, arrays, clusters.

Output Verification Tools : Waveform Graphs, Waveform charts, files I/O, local and global variables.

**Data Acquisition** : Introduction, transducers, Signals, Signal conditioning, DAQ Hardware configuration, DAQ Hardware, Analog inputs, Analog outputs, counters, Digital I/O, DAQ software architecture, DAQ assistant.

IMAQ Vision : Vision basics, Image processing and analysis, particle analysis, Machine vision, Machine vision hardware and software, building a complete Machine Vision system, Acquired and displaying images with NI-IMAQ driver software, Image processing tools and functions in IMAQ vision, Machine Vision applications.

*Textbooks*

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

*References*

1. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW,” PHI learning Pvt. Ltd 2006.

2. Jeffrey Travis,” LabVIEW for everyone,” Pearson Education 2009.

**MTIE-2.3 Elective – III(A) Industrial Communication Systems**

Introduction: importance of communication in industry, hierarchy of factory automation, evolution of technology in control systems.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.

Physical layer options: Network topologies, interface standards, RS232,RS 422,RS 485,IEEE 488(GPIB): Talkers, Listeners and controllers, Connector and signal lines, Data bus, Handshake lines, Handshaking, Control bus, Data bus transfer timing, Physical connection, Electrical characteristics, IEEE 488.2, IEEE 488.2 control sequences and protocols, HS 488, Handshake, HS 488 data transfer flow control, System configuration effects on HS 488, HS 488 configuration messages.

HART Communications: HART communication technique, Cable specifications, HART commands, Benefits of HART,Token buses and rings: IBM token ring protocol, Function of a bridge, Function of a repeater and splitter.Ethernet or CSMA/CD: MAC protocol, Different ways of implementation, Vital statistics. Moving up the layers: Function of a router, Gateways, Remote file request, FDDI, Typical enterprise network.

Field bus and device networks: Introduction, The CIM pyramid, Field bus characteristics, Field bus configuration, Advantages of Field bus, Connecting Field bus to PLC and other devices, Connection with analog signals, Intelligent/ smart hybrid signals, pure digital communication, open system and interoperability, Field bus requirements, types of Field buses.

Foundation field bus: Architecture, Physical layer, wire media characteristics, communication, data link layer, Field bus media access control, Data Link Control, Objective oriented design, Application layer, System and Network management, Function block application process, field bus benefits.

*Reference Books*

1. M.M.S. Anand , “Electronic Instruments and Instrumentation Technology”, Prentice Hall of India Private Limited.

2. Krishna kant-Computuer based industrial control, PHI.

3. Noltingk B.E., “*Instrumentation Reference Book*”, 2nd Edition, Butterworth Heinemann, 1995.

4. B.G. Liptak, Process software and digital networks, 3rd Edition, CRC press, Florida.

**MTIE-2.3 Elective – III(B) Robotics and Automation**

Introduction: Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision.

Robot arm kinematics : Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – DenavitHattenberg representation and various arm configurations.

Robot arm dynamics**:** Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations –GeneralisedD’Alembert equations of motion.

Planning of manipulator trajectories**:** General consideration on trajectory planning- joint interpolation & Cartesian path trajectories.

Control of robot manipulators:PID control - Computed torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control.

Industrial robots: Industrial robots for welding, painting and assembling-Remote controlled robots- robots for nuclear, chemical and thermal plants- industrial automation-typical examples of automated industries.

*REFERENCE BOOKS*

1. Fu, K.S. Gonazlez, R.C. and Lee, C.S.G., “Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1968 (II printing).

2. Wesley, E. Sryda, “Industrial Robots: Computer interfacing and Control” PHI, 1985.

3. Asada and Slotine, “Robot Analysis and Control”, John Wiley and Sons, 1986.

4. Philippe Coiffet, “Robot Technology” Vol. II (Modelling and Control), Prentice Hall INC, 1981.

5. Groover M. P. Mitchell Wesis., ‘Industrial Robotics Technology Programming and Applications’, Tata McGraw-Hill, 1986.

**MTIE-2.3 Elective – III(C) Power Plant Instrumentation**

Basics of power plant operation- major input variables, major control variables

Automation strategy: Distributed system structure, automatic boiler control, diagnostic function and protection. Automatic boiler control- basic boiler operation- block diagram, ID,FD fans, Unit type boilers

Combustion controls; series-parallel operation, hardware schemes, optimizing control for air-flow, loss-efficiency curves, oxygen/CO trimming control, comparison,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, Advanced control aspects: Adaptive variable pressure control, combined plant control

Digital electrohydraulic governor: block diagram, basic functions, turbine speed control, valve actuation.Automatic startup systems- block diagram, steps in turbine speed control, thermal stress control.

Man-Machine interface: types of displays, Software system-online functions, graphic display, Application functions

*Reference 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.

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

**MTIE-2.4 Elective – IV(A) Advanced Sensors**

Chemical Sensors: Amperometry-Potentiometry-Conductivity sensors- Semi conductive sensors-MEMSsensors. 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.

**MTIE-2.4 Elective – IV(B) Piping and Instrumentation**

Types of flow sheets, Flow sheet Presentation, Flow Sheet Symbols, Process flow diagram- Synthesis of steady state flow sheet - Flow sheeting software. P & I D objectives, guide rules, Symbols, Line numbering, Line schedule, P & I D development, typical stages of P & I D. P & I D for rotating equipment and static pressure vessels, Process vessels, absorber, evaporator. Control System for Heater, Heat exchangers, reactors, dryers, Distillation column, Expander.

Applications of P & I D in design stage - Construction stage - Commissioning stage -Operating stage - Revamping stage - Applications of P & I D in HAZOPS and Risk analysis.

*REFERENCEBOOKS*

1. Applied Process Design for Chemical and Petrochemical Plants: Ernest E. Ludwig, Vol.-I Gulf Publishing Company, Houston, 1989.

2. Plant Design and Economics for Chemical Engineer: Max. S. Peters and K.D.TimmerhausMcGraw Hill, Inc., New York, 1991.

3. Chemical Process Synthesis and Engineering Design: Anil Kumar, “”, Tata Mc-GrawHill publishing Company Limited, New Delhi - 1981.

4. Process Flow sheeting: N. Westerberg, et al. Cambridge University Press, 1979.

**MTIE-2.4 Elective – IV(C) Steel Plant Instrumentation**

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.

*Reference 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.

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

**MTIE-2.5 Audit Course**

**MTIE-3.1 Elective V (A) Fiber Optics and Laser Instrumentation**

Principles of light propagation through fiber- Different types of fibers and their properties– transmission characteristics of optical fibers - absorption losses-scattering losses-dispersion. Fabrication of fiber components- Optical fiber as cylindrical waveguide, fiber-optic polarizer.

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.Distributed fiber-optic sensors-OTDR and OFDR principles in temperature measurement.

Characteristics and fundamentals of lasers – Laser emission and light amplification – Properties of laser beams – Laser modes – Resonator configuration – Q-switching mode locking – Single frequency operation. Types of lasers – Gas lasers – Solid lasers – liquid lasers – semiconductors lasers.

Lasers for Analysis – Laser application in holographic microscopy – holographic interferometer and applications-Holography for non-destructive testing – Medical applications of lasers.

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

*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, AddisonWesley, 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.

**MTIE-3.1 Elective V(B) Fuzzy Logic and Neural
Networks and Control**

Neural Networks: Introduction - Biological neurons and their artificial models – Learning, adaptation and neural networks learning rules types of neural networks – Single layer, multiplayer – Feed forward, feedback networks; back propagation – Learning and training – Hop field network.

Neural Networks in Control: Neural network for non-linear systems – Schemes of neuro control – System identification forward model and inverse model – Indirect learning neural network control applications – Case studies.

Fuzzy Logic**:** Fuzzy sets – Fuzzy operation – Fuzzy arithmetic – Fuzzy relations – Fuzzy relational equations – Fuzzy measure – Fuzzy functions – Approximate reasoning – Fuzzy propositions – Fuzzy quantifiers – If–then rules.

Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries Fuzzy sets in commercial products basic construction of fuzzy controller Analysis of static properties of fuzzy controller Analysis of dynamic properties of fuzzy controller simulation studies case studies fuzzy control for smart cars.

Neuro Fuzzy and Fuzzy Neural Controllers: Neuro fuzzy systems: A unified approximate reasoning approach Construction of role bases by self-learning: System structure and learning algorithm. A hybrid neural network based Fuzzy controller with self-learning teacher. Fuzzified CMAC and RBF network based self-learning controllers.

*REFERENCE BOOKS*

1. Jacek. M. Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1999.

2. Kosko, B. “Neural Networks and Fuzzy Systems”, Prentice Hall of India Pvt. Ltd., 1994.

3. Klir G.J. & Folger T.A. “Fuzzy sets, uncertainty and information”, Prentice Hall of India Pvt. Ltd., 1993.

4. Zimmerman H.J., “Fuzzy set theory – and its application” – Kluwer Academic Publishers, 1994.

5. Driankov, Hellendroon, “Introduction to Fuzzy Control”, Narosa Publishers.

6. Farin Wah S.S., Filev, D. Langari, R. “Fuzzy control synthesis and analysis”, John Wiley and Sons, 2000.

**MTIE-3.1 Elective V(C) Environmental Analysis Instrumentation**

Electromagnetic radiation, Characteristics - Interaction ofe.m. radiation with matter - Spectral methods of analysis - absorption spectroscopy – Beer’s law - radiation sources - monochromators and filters - diffraction grating - ultraviolet spectrometer - single beam and double beam instruments.

Particles emitted in radioactive decay - nuclear radiation detectors - injection chamber - Geiger - Muller counter - proportional counter - scintillation counter - Semiconductor detectors.

Measurement techniques for water quality parameters - conductivity - temperature - turbidity. Measurement techniques for chemical pollutants - chloride - sulphides - nitrates and nitrites - phosphates - fluoride - phenolic compounds.

Measurement techniques for particulate matter in air. Measurement of oxides of Sulphur, oxides of nitrogen unburnt hydrocarbons, carbon-monoxide, dust mist and fog.

Noise pollution measurement of sound, tolerable levels of sound. Measurement of sound level. Measurement techniques for soil pollution.

*REFERENCEBOOKS*

1. H.H. Willard, Merrit and Dean, Instrumental Methods of Analysis, 5thEdn., 1974.

2. R.K. Jain, Fundamentals of Mechanical and Industrial Instrumentation. 1985.

3. S.P. Mahajan, Pollution Control in Process Industries, Tata McGraw Hill, 1985.

G. N. Pandey and G.C. Carney, Environmental Engineering, Tata McGraw-Hill, 1989.

**MTIE-3.2 Open Elective VLSI Design**

Introduction: Introduction to IC technology-MOS, PMOS, NMOS, CMOS, BiCMOS Technologies. Fabrication, Fabrication sequence - Oxidation, Lithography. Diffusion, Ion implantation, Metallization, Encapsulations. Basic Electrical Properties of MOS and BiCMOS circuits -Ids-Vds relationships, MOS transistor Threshold voltages, figure of merit, NMOS inverter, and CMOS inverter analysis and design-BiCMOS inverters.

VLSI circuit Design Processes: VLSI design flow, MOS layers, Stick diagrams, Design rules and layout, 2µm CMOS Design rules for wires, contacts and transistors-Layout diagrams for NMOS and CMOS inverters and gates- Scaling of MOS circuits- Limitations of scaling.

Gate level Design: Logic gates and other complex gates, switching logic-alternate gate circuits-Basic circuit concepts-sheet resistance Rs and its concept to MOS- Area capacitance units- calculations-ä delays- Driving large capacitance loads- Wiring capacitive loads- wiring capacitances- Fan-in and fan-out- choice of layers.

Semi-custom Integrated circuit Design: Design approach of semi-custom and Full-custom ASICS, Standard Cell design, Programmable Logic Array, Programmable Array Logic, programmable gate arrays- CPLDs, FPGAs - etc.

VHDL Synthesis: Circuit Design flow- Circuit synthesis- Simulation-Layout-Design capture tools- Design verification tools- Test principles- Test vector generation, scan based techniques, Boundary scan test(BST), Built-in-self Test(BST) techniques, Testing and qualification.

*REFERENCE BOOKS*

1. Essentials of VLSI circuits and Systems: Kamran Eshraghian, Eshraghian Douglas and A.Pucknell—PHI-2005 Edition.

2. Principles of CMOS VLSI Design: Weste and Eshranghian—Pearson Education-1999.

3. Introduction to VLSI circuits and systems-John P.Uyemura-JohnWiley-2003

4. Modern VLSI Design- Wayne Wolf, Pearson Education, 3rd Edition, 1997.

5. Digital Integrated Circuits: A Design Perspective- J. Rabaey-Prentice Hall India, 1997.

**Audit Course**

**ENGLISH FOR RESEARCH PAPER WRITING**

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

*Reference Books*

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman’sbook.

4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

**DISASTER MANAGEMENT**

Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War And Conflicts.

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics.

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global CoOperation In Risk Assessment And Warning, People’s Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

*Reference Books*

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.

2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.

3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

**SANSKRIT FOR TECHNICAL KNOWLEDGE**

\* Alphabets in Sanskrit.

\* Past/Present/Future Tense.

\* Simple Sentences

\* Order

\* Introduction of roots

\* Technical information about Sanskrit Literature

\* Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

*Reference Books*

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi

2. “Teach Yourself Sanskrit” Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication

3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

**VALUE EDUCATION**

\* Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism.

\* Moral and non- moral valuation. Standards and principles.

\* Value judgements

\* Importance of cultivation of values.

\* Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.

\* Honesty, Humanity. Power of faith, National Unity.

\* Patriotism. Love for nature, Discipline.

\* Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline.

\* Punctuality, Love and Kindness.

\* Avoid fault Thinking.

\* Free from anger, Dignity oflabour.

\* Universal brotherhood and religious tolerance.

\* True friendship.

\* Happiness Vs suffering, love for truth.

\* Aware of self-destructive habits.

\* Association and Cooperation.

\* Doing best for saving nature.

\* Character and Competence –Holy books vs Blind faith.

\* Self-management and Good health.

\* Science of reincarnation.

\* Equality, Nonviolence,Humility, Role of Women.

\* All religions and same message.

\* Mind your Mind, Self-control.

\* Honesty, Studying effectively.

*Reference Books*

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

**CONSTITUTION OF INDIA**

\* 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.

**PEDAGOGY STUDIES**

\* Introduction and Methodology:

\* Aims and rationale, Policy background, Conceptual framework and terminology.

\* Theories of learning, Curriculum, Teacher education.

\* Conceptual framework, Research questions.

\* Overview of methodology and Searching.

\* Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.

\* Curriculum, Teacher education.

\* Evidence on the effectiveness of pedagogical practices.

\* Methodology for the in depth stage: quality assessment of included studies.

\* How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

\* Theory of change.

\* Strength and nature of the body of evidence for effective pedagogical practices.

\* Pedagogic theory and pedagogical approaches.

\* Teachers’ attitudes and beliefs and Pedagogic strategies.

\* Professional development: alignment with classroom practices and followup support.

\* Peer support.

\* Support from the head teacher and the community.

\* Curriculum and assessment.

\* Barriers to learning: limited resources and large class sizes.

\* Research gaps and future directions.

\* Research design.

\* Contexts.

\* Pedagogy.

\* Teacher education.

\* Curriculum and assessment.

\* Dissemination and research impact.

*Reference Books*

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, ‘learning to read’ campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

**STRESS MANAGEMENT BY YOGA**

\* Definitions of Eight parts ofyog. ( Ashtanga )

\* Yam and Niyam.

Do‘s and Don’t’s in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

\* Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii) Regularization of breathing techniques and its effects-Types ofpranayam

*Reference Books*

1. ‘Yogic Asanas for Group Tarining-Part-I” : Janardan Swami Yogabhyasi Mandal, Nagpur

2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**

Neetisatakam-Holistic development of personality

\* Verses- 19,20,21,22 (wisdom)

\* Verses- 29,31,32 (pride & heroism)

\* Verses- 26,28,63,65 (virtue)

\* Verses- 52,53,59 (dont’s)

\* Verses- 71,73,75,78 (do’s)

\* Approach to day to day work and duties.

\* Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48,

\* Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,

\* Chapter 18-Verses 45, 46, 48.

\* Statements of basic knowledge.

\* Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68

\* Chapter 12 -Verses 13, 14, 15, 16,17, 18

\* Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

\* Chapter 4-Verses 18, 38,39

\* Chapter18 – Verses 37,38,63

*Reference Books*

1. “Srimad Bhagavad Gita” by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata

2. Bhartrihari’s Three Satakam (Niti-sringar-vairagya) by P.Gopinath,

3. Rashtriya Sanskrit Sansthanam, New Delhi.