## SCHEME OF INSTRUCTION AND EXAMINATION
### B.TECH (INSTRUMENTATION ENGINEERING)

#### B.TECH. 1/4 : Common to All Branches

#### B.TECH. 2/4 : SEMESTER-I

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THE TRANSISTOR AT LOW FREQUENCIES: Typical circuits for CB, CE and CC configurations – Analysis of transistor amplifier using hybrid parameters – Hybrid parameters from graphical characteristics.

THE TRANSISTOR AT HIGH FREQUENCIES:  The hybrid-pi model of a CE transistor – Analysis of an RC-Coupled CE amplifier for low, mid and high frequencies – The gain and phase plots of an RC-coupled CE amplifier

THE TRANSISTOR FEEDBACK AMPLIFIERS: Classification of amplifiers—Feedback concept—Positive and negative feedbacks—Block diagram of a signal – loop feedback amplifier – Output sampling modes—Input mixing modes—Feedback topologies of an amplifier—Transfer gain of a signal – loop feed back amplifier – Advantages of negative feedback in an amplifier—Typical amplifier circuits with negative feed back

TRANSISTOR POPWER AMPLIFIERS:  Class A, Class B and Class C operating conditions—outline of signal-end class A and class B transformer- coupled power amplifiers – An outline of nonlinear distortion—Analysis of Class A push-pull power amplifier—Advantages of push-pull system—Outline of class B push-pull power – pull system – outline of class B push-pull power amplifier—crossover distortion – Class AB operation in push-pull configuration – complementary symmetry power amplifier—phase inverter circuits for push-pull input—Impedance matching output transformer
RECTIGIERS AND POWER SUPPLIES: Half-wave, full-wave and bridge rectifiers – Ripple factors and efficiencies—outline of filter circuits – Analysis of full-wave rectifier with condenser filter-zenor diode voltage regulator – Series Voltage regulator

RESONANCE AND THEOREMS: Series resonance—Parallel resonance – Thevenin’s theorem – Norton’s theorem – Miller’s theorem and its dual—Maximum power transfer theorem

TWO- PORT NET WORKS: Z, Y, h and ABCD parameters – Equivalent circuits with Z, Y and h parameters –

CIRCUIT TRANSIENTS: Direct current transients in RL, RC and RLC series circuits – Alternate current transients in RL, RC and RLC series circuits

REFERENCES:

1. Electronic Devices and Circuits, by Mailman and Halkias
2. Integrated Electronics : Analog and Digital circuits and systems, by Millman and Halkias
5. Circuit Theory, by Umesh Sinha

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INE : 213- STRENGTH OF MATERIALS AND THEORY OF MACHINES

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Simple stresses and strains – tensile, compressive and shear stresses. Elastic limit, Hook’s law, stress-strain relation, poission’s ratio, Moduli-relation among them. Stresses in bars of varying section, composite sections, temperature stresses. Change in modulus if all the lateral strains are prevented.

Bending moment and shearing force – cantilever, simply supported beams, pointed loads, uniformly distributed loads, S.F and D.M diagrams. Over hanging beams.

Link and element- lower and higher pairs- kinematic chain mechanisms with turning and sliding pairs-criteria, degrees of freedom, joint analysis-Grubler’s criteria- inversion of single slider and double slider crank chains

Exact straight line mechanisms- pantograph, peaucellier mechanism, Harts mechanism, Scott-Russel mechanism, Approximate straight line mechanisms- Scott-Russel, Watt, Tchebicheff’s mechanism, Roberts mechanism, Modified Scott-russel, Grass hopper mechanism.

Friction and bearings- limiting friction, laws, limiting angle, angle of repose, Equilibrium of a body on a rough, inclined plane, friction between screw and nut, mechanical efficiency-friction in journal bearings, friction circle, work done-ball and roller bearings- Hoffman transmission bearings
Text books:
1. J.A.Taraporebala- Strength of materials
4. Khurmi R.s. and Gupta J.K- theory of machines

**INE : 214 - ELECTRICAL MACHINES**

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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.

MAGNETIC CIRCUITS:

TRANSFORMERS:

D.C.Machines-construction-armature windings – e.m.f equation-armature reaction and commutation-Generator characteristics-D.C.motor back e.m.f-speed torque characteristics-starters-speed control testing.

Synchronous machines-the alternator-frequency -single and poly phase windings-synchronous impedance-armature reaction-e.m.f.equation-synchronous motor, nature of torque, vector diagram-characteristics of a synchronous motors-starting methods.


**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 - SYSTEM DYNAMICS AND TRANSDUCERS**

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</table>
**Measurements and Measurement Systems**: What is measurement – Measuring Instruments and measurement systems – Functional elements and Block diagram of a measurement system – Classification of the measuring instruments - Specifications of Instruments – Standards of measurement – International system of units- Calibration of measuring instruments.

**Errors in measurements**: Types of errors – Sources of errors – Methods of minimization or elimination of errors- Statistical analysis of errors – selection of instruments.


**Thermo Electric Transducers**: Photo voltage sensors – Piezo electric sensing elements – Turbine flow transducers – Electromagnetic flow sensors – Electromagnetic speed sensors – Photo electric speed sensors.

**Books**:
1. A Course in Mechanical Measurements and Instrumentation – A.K.Sawhney

**INE : 216 - DIGITAL ELECTRONICS AND LOGIC DESIGN**

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**Digital Principles**: Definition for Digital signals, Digital wave forms, Digital logic, moving and storing Digital information, Digital operations

**Number systems & codes**: Review of number systems, weighted codes, conversion from one to another, non weighted codes, error detecting codes, error correcting codes , binary arithmetic.
**Digital logic & Boolean algebra**: Basic gates OR, AND, NOT, universal gates NAND, NOR, introduction to HDL. Boolean law & theorems, representation of switching functions, Karnaugh map representation, minimization using Karnaugh map, SOP and POS methods. Design of single output and multi output functions using conventional gates and HDL implementation models.

Arithmetic circuits: Half & full adders and subtractors, 4 bit binary adder, fast adder, ALU, arithmetic circuits using HDL.

Data processing circuits: Multiplexers, demultiplexure, 1 of 16 decoder, seven segment decoders, encoders, HDL implementation of data processing circuits.

Synchronous sequential logic: RS flip-flops, gated flip-flops, edge triggered RS, D, JK flip-flops, master slave flip-flop, T flip-flop switch contact bounce circuits, analysis of sequential circuits, HDL implementation of Flip-Flops.


D/A conversion and A/D conversion: Variable register networks, Binary ladders, D/A converters, D/A Accuracy and resolution. A/D converters- simultaneous, counter, continuous, Dual slope techniques.

Analog Switches: Switch configuration, Basic operating principles of switch diode transmission gates. High speed S/H circuits BJT and FET gates, S/H circuits CMOS gates, multiplexing introduction to comparators.

Clocks & Timing Circuits: Clock wave forms, TTL clock, Schmitt Trigger, 555 Timer- astable & mono stable pulse generators, Mono stables with input logic, pulse performing circuits.

Text Books:
1. Digital Principles and Applications. Albert Paul Malvino and Donaldp. Leach, T.M.H.
3. Digital Logic and Computer Design by M. Morris Mano, P.H.I.

**INE: 221: ENVIRONMENTAL SCIENCE**

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Module 1: Introduction
- Definition, scope and importance
- Measuring and defining environmental development: indicators (1 lecture)

Module 2: Ecosystems
- Introduction, types, characteristic features, structure and functions of Ecosystems
- Forest
- Grassland
- Desert
- Aquatic (lakes, rivers, and estuaries)

Module 3: 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

Module 4: 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

Module 5: 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, composting, vermiculture
  - Urban and industrial wastes, recycling and re-use.
- Nature of thermal pollution and nuclear hazards
- Global Warming
- Acid rain
  - Ozone depletion

Module 6: 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

Module 7: 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

Module 8: Social Issues and the environment

- Population growth and environment
- Environmental education
- Environmental movements
- Environment vs Development

Module 9: 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 of pollution) act
  - Env. Protection act
  - Wild life protection act
  - Forest conservation act
- Coastal zone Regulations
- Institutions and policies relating to India
- Environmental Governance

Module 10: International Conventions

- Stockholm Conference 1972
- Earth Summit 1992
- World Commission for Environmental Development (WCED)

Module 11: Case Studies

- Chipko Movement
- Narmada Bachao Andolan
- Silent Valley project
- Madhura Refinery and Taj Mahal
- Industrialization of Pattancheru
- Nuclear reactor reactor at Nagarjuna Sagar
- Tehri Dam
- Ralegaon Siddhi (Anna Hazare)
- Kolleru Lake-aqua culture
- Florosis in Andhra Pradesh

Module 12: Field work:
Visit to a local area to document and mapping environmental assets 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. (5 lectures)

**INE : 222 - ELECTRICAL MEASUREMENTS AND MEASURING INSTRUMENTS**

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

MEASUREMENT OF VOLTAGE, CURRENT: Electrical analog instruments, classification and constructional details, galvanometers, operating principle dynamic response, measurement of galvanometer constants, moving-iron, PMMC, Electro dynamic, electro static and inductive type instruments, range extension

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

MEASUREMENT 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**

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The Op-AMP: Block diagram of typical op-amp types of integrated circuits, power supplies for integrated circuits. Electrical characteristics of an op-amp, measurement of op-amp parameters,
equivalent circuits 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 feed back configuration voltage-series feed back amplifier analysis, voltage shunt feed back amplifier analysis. Basic differential amplifier and instrumentation amplifiers.

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

FREQUENCY RESPONSE OF OP-AMP: DC and AC amplifiers, the peaking amplifier, summing, scaling and averaging amplifiers. A sub tractor, V/I converter with floating load, low-voltage Dc and AC voltmeters, V/I converter with ground load, I/V converter. DAC using I/V converters. DC coupled follower, AC coupled voltage follower with input resistance bootstrapped. 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.

OSCILLATORS: Phase shift oscillator, wien bridge oscillator, quadrature oscillator, square wave generator, triangular generator, saw tooth wave generator, voltage-controlled oscillator.

COMPARATORS AND CONVERTERS: basic comparator, the transfer characteristics, zero-crossing detector, the Schmitt trigger, voltage limiter, window detectors, V/F and F/V converters, positive and negative clippers, positive and negative clampers, precision half wave rectifier, absolute value output circuit, peak detector, sample-hold circuit.

LOGARITHMIC AMPLIFIERS: logarithmic amplifier, antilog amplifier, logarithmic multiplier, log ration amplifier.

SPECIFIED IC APPLICATIONS: the 555 as square wave generator, 555 as free running ramp generators, block diagram of a phase locked loop and its operating principle, 565 PLL as a frequency multiplier and as an FSK demodulator.

POWER AMPLIFIERS: Power amplifiers using power boosters LM 380 audio power amplifier.

VOLTAGE REGULATORS: three-terminal fixed positive and negative voltage regulators three terminal adjustable positive and negative voltage regulators. A switching regulator.

TEXT BOOKS:
1. Op-amps and linear integrated circuits by RamaKant A.Gayakwad, P.H.I.
2. Op-amps and linear integrated circuits by Robert Coughlin.
3. Applications of analog integrated circuits by Sidney soclof PHI.

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TRANSISTOR TUNED RF AMPLIFIERS: An outline of single tuned and double tuned amplifiers with inductive coupling


TRANSISTOR SINUSOIDAL OSCILLATORS: Classification of oscillators – Oscillator as a positive feedback amplifier – Barkhausen criterion – constituents of an oscillator – Analysis of phase shift oscillator – Analysis of Colpitt’s oscillator – analysis of Wien Bridge oscillator – Crystal oscillator – Frequency and amplitude stabilities.


TRANSISTOR VOLTAGE TIME-BASE GENERATORS: General features of a time-base signal – Methods of generating time-base waveforms – Exponential voltage sweep circuit – voltage sweep circuit using constant current source charging of a condenser – Miller time base generator – Bootstrap voltage time-base generator

TRANSISTOR CURRENT TIME-BASE GENERATORS: A simple current sweep circuit – a transistor current time-base generator


REFERENCES:
1. Electronic Devices and circuits, by Millman and Halkias
2. Integrated electronics : Analog and Digital Circuits And System, by Millman and Halkias
3. Pulse, Digital and Switching waveforms, by Millman and Taub
4. Electronic Fundamentals and applications by John D. Ryder

Measurement of displacement – vibration - velocity acceleration - mechanical, electrical, optical types of measurement systems.


Measurement of Viscosity and Consistency: basic principles of capillary viscometers, friction type viscometers, float type viscometers, ultrasonic viscometer, electrical type viscometers, coefficient of viscosity, and temperature compensation.

Pressure measurement systems: Measurement of pressure and vacuum ,units of pressure, Elastic type pressure gauges, electrical pressure gauges.


Liquid level measuring systems: Classification of level measurement methods and devices, mechanical methods, electrical methods, Radiation methods.


Books:
1. Mechanical and Industrial Instruments – R.K Jain.
MECHANICAL PROPERTIES: Tensile Testing-Impact Testing-hardness Tests-Brinell, Vickers and 
Rockwell tests-Plastic deformation-Fracture toughness-Creep-fatigue-Cold work-Recovery-
recrysallisation-Grain growth.

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

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 MATERIALS : Ferromagnetism and related Phenomena- Domain 
structure-Hysterisis 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,homeojunction and Heterojunction- Transistor action.

BASIC SHAPING PROCESSES: Sand Casting- Die casting-Forging processes- Soldering and 

TEXTBOOKS:
1. Material Science and Engineering by V.Ragavan-prentice Hall of India, New Delhi.

REFERENCE BOOKS:
1. Introduction to Material science for Engineers by J.F.Shackelford, Macmillan publishing 
   Co., New York
   London.

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GEOMETRICAL OPTICS: Laws of reflection, critical angle – Linear and angular magnifications 
cardinal points, aberrations – corrections.

TELESCOPES & MICROSCOPES & PHOTOGRAPHIC SYSTEMS : Reflecting and refracting


Text Books :
1. Introduction to classical and modern optics by Jurgen R.Meyer – Arendt.
2. Optics by Finchem and freeman.
4. Laser & Hologrophy by Thyganrjn.

### INE : 312 - ELECTRONIC INSTRUMENTATION

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


### INE : 313 – MICRO PROCESSORS AND APPLICATIONS

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Programmable peripheral devices – 8255PPI, 8253 programmable interval timer, 8259 programmable interrupt controller, 8257 DMA controller, and 8279 keyboard / display device. Serial I/O and data communication techniques – software controlled asynchronous – serial I/O lines – hardware controlled serial I/O using programmable devices, 8251 USART.

Microprocessor applications – a smart scale design – µp based temperature and level measuring system. Overview of industrial process control system. An 8085 based industrial process control system – block diagram – comparison of contemporary 8 bit microprocessors – zilog z 80, Motorola 6800 etc.


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**INE : 314 – CONTROL ENGINEERING 1 (CONTROL SYSTEM ENGINEERING)**

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The control systems, closed loop control, open loop control, servo mechanisms, Differential equations of physical systems, 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.

The concept of stability, necessary conditions for stability, Hurwitz stability criterion, Routh stability criterion, application of a Routh stability criterion to Linear feedback systems. The Root locus concept, construction of root loci, construction rules, determination of roots from root locus. Relation between time and frequency response, polar plots, Bode plots, Niquist stability criterion, gain margin and phase margin, closed loop frequency response Nichols chart.

computer arithmetic, point representations, introduction to CISC processor architecture, instruction set and addressing modes, hardware design principles polling of processors, memory types & interfacing & timing I/O handling, interrupts & DMA & device interfaces ? CRT, floppy disk, HDD, optical disk, serial interfaces & data acquisition, operating system concepts & architectural support privileged mode, software interrupts, memory hierarchy and virtual memory, multiprocessors concept, cache memory, pipelining and introduction, RISC processors, super scalar processors.

UNIT – IV

LAPLACE TRANSFORMS: Review of Laplace transforms, partial fraction expansion, inverse Laplace transforms, concept of region of convergence (ROC) for Laplace transforms. Constraints on ROC for various classes of signals, properties of Laplace transforms, relation between Laplace transform and Fourier transform of a signal. Laplace transform of a certain signals using waveform synthesis.

UNIT – V


TEXT BOOKS:

1. Signals, systems and communications – by B.P Lathi, BS publications.
2. Signals and systems – by A.V Oppenheim , AS Willesky & SH Nawab, PHI

REFERENCE:

1. Signals and systems – by Simon Haykins, Wiley Student Ed.

INE : 316 – ELECTIVE (B) RELIABILITY AND SAFETY ENGINEERING

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Reliability, introduction – definition of reliability failure data analysis – introduction – failure density, mean failure rate – mean time to failure (MTTF) – mean time between failure (MTBF) MTTF in terms of failure density – generalisation – reliability in terms of hazard rate and failure density.


and cut set methods – use of Boolean algebra – basic operations truth tables – demogans thermos – applications to reliability analysis.


**INE : 316 - ELECTIVE (C) - NON-DESTRUCTIVE TESTING**

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


### INE : 316 - ELECTIVE(D) - ADVANCED SENSORS

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**Text books:**
3. Sensors and Actuators: No.8,1985(pp.227-233);No.10.1986(pp.65-82);No.12.1987(pp.129-144).

### INE:319 – SOFT SKILLS

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**Communication:**
- Importance of communication
- Non verbal communication
- Personal appearance
- Posture
- Gestures
- Facial expressions
- Eye contact
- Space distancing

**Goal setting:**
- Immediate, short term, long term,
- Smart goals, strategies to achieve goals

**Time management:**
- Types of time
- Identifying time wasters
- Time management skills
Leadership and team management:
Qualities of a good leader
Leadership styles
Decision making
Problem solving
Negotiation skills

Group discussions:
Purpose (Intellectual ability, creativity, approach to a problem, solving, tolerance, qualities of a leader)
Group behavior, Analyzing performance

Job interviews:
Identifying job openings
Preparing resumes & CV
Covering letter
Interview (Opening, body-answer Q, close-ask Q),
Types of questions

Reference books:
1. ‘Effective Technical Communications’ by Rizvi M. Ashraf, McGraw–Hill Publication
2. ‘Developing Communication Skills’ by Mohan Krishna & Meera Banerji, Macmillan
3. ‘Creative English for Communication’ by N.Krishnaswami & T.Sriraman, Macmillan

INE : 321 – DIGITAL SIGNAL PROCESSING

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INTRODUCTION TO DIGITAL SIGNALS AND SIGNAL PROCESSINGS: Continuous – time and discrete –time signals, discrete time signal and their characteristics, discrete – time signals from continuous time signals, linearity, shift invariance and convolution sum, stability and casuality, linear constant coefficient difference equations, frequency response of discrete – time system transfer function relationship.


INE : 322 – ADVANCED MICROPROCESSORS & MICRO CONTROLLERS

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8051 Micro Controller Family - Architecture, Parallel and Serial I/O - Instruction Set – Programming.

8096 Micro Controller – CPU, RAM space, Memory space, High Speed Input & Outputs, Analog Inputs - Serial I/O Ports - Parallel I/O Ports and Watch Dog Timer.


INE : 323 - INDUSTRIAL ELECTRONICS

POLY PHASE 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.


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


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Tuning of controllers: Continuous oscillation and damped oscillation methods-problems, 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: I/P, P/I converters, pneumatic, electric and hydraulic actuators. Relief and safety valves, relays and volume boosters.

Control valve sizing: Flow formulae through control valves. Viscosity correction, range ability, turn down cavitation and flashing in control valves.


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### INE : 325 – CONTROL SYSTEMS II

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Introduction to complex control system, state variable analysis of dynamic systems, conical forms, stability, controllability and observability.

Continuous and discrete systems, linear system design by state variable feedback. Introduction to optimal control quadratic performance index and regular problems.

Non linear elements and systems – phase plane and describing function methods.

Stability analysis and liapunov's method.


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### INE : 326 - ELECTIVE (A) PETRO CHEMICAL PLANT INSTRUMENTATION

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Basics of petro-chemical production, importance of automation

Automation strategy: different levels, input, output data
Batch process description and terminology: batch process classification, batch automation, recipe activities, control functions.

Batch process and their automation: batch standards, definitions, models, characteristics of a batch process, equipment for batch automation, batch control functions.

Distillation column controls: basic control, columns, condensers, reboilers, models-steady state and dynamic.

Advanced control strategies: process model, feed forward systems, supervisory control.

Model based control, multi variable control, dynamic matrix control, neural control.

Pollution control and monitoring for petro-chemical plant environment.

**Text Books:**
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.

**Reference:**

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#### INE : 326 - ELECTIVE(B) POWER PLANT INSTRUMENTATION

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Basics of power plant operation- major input variables, major control variables
Automation strategy: Distributed hierarchical system, software for data logging- input/output variables- direct digital control, man- machine interface, communication
Automatic boiler control- basic boiler operation
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

Digital electro hydraulic governor: basic functions, turbine speed control

Automatic startup systems- safety systems

**Text Books:**
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.

**Reference:**
INÉ : 326 - ELECTIVE (C) STEEL PLANT INSTRUMENTATION

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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:
2. Krishna Kant: Computer based industrial control, Prentice Hall India Pvt Ltd.
3. George Stephanopoulos: Chemical process control; Prentice Hall India Pvt Ltd.

Reference:

INÉ : 326 - ELECTIVE (d) INSTRUMENTATION FOR SPECIAL PROCESSES

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Reference:
1. Process control by Liptak

INÉ : 411 - CONTROL ENGINEERING III (COMPUTER BASED PROCESS CONTROL)

INTRODUCTION TO VLSI TECHNOLOGY:
Various types of technologies – Bi-polar, MOS, CMOS, NMOS, PMOS.
The generic process flow for a typical cMOS including device structures. Current states of the art in terms of devices, feature sizes. Modeling at various levels – Process modeling, devices modeling, circuit modeling. Circuit delays as function of technology and other parameters.

SEMI-CUSTOM INTEGRATED CIRCUIT DESIGN:
Gate arrays including channeled sea-of gates and FPGA. Standard Cells. Design approach for full custom and semi-custom devices.

VLSI DESIGN TOOLS:
VHDL synthesizers, simulators, layout, design rule checks, test vector generation, BIST.

THE DESIGN FLOW:
Capturing of user impediments, circuits synthesis, simulations, layout, post layout simulators, foundry specific features, testing, qualification.

PACKAGING:
Types of packages, constraints, thermal models.

ANALOG DESIGNS:
Circuits, performance parameters

Reference:

Introduction of VLSI by Mead and Conway.


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Principles of plant organisation, Organisation design; responsibility, authority, span of control; organisation chart. Plant location, facilities layout and line balancing-factors governing plant location, local economics and rural vs urban plant sites; objectives principles of layout, process, product and cell layout; work station design, line balancing.

Principles and practice of management-function of management, scientific management types of organisations. Types of ownership - advantages and disadvantages. Types of leaders and leadership styles. Personnel management, recruitment and training. Safety and safety programmes, welfare measures, industrial disputes and grievance handling procedures, employee participation and union management relations.

Quality and quality control quality assurance, ISO 9000 and total quality management (TOM), reliability, maintainability and maintenance management. Small scale industries - role and scope at small scale industries, government assistance and incentives to small scale industries, assistance to educated reemployed and a model scheme to start a small scale industry.


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 – neuronal firing measurements EEG and EMG.


**Text books:** 1. Chromwell et al biomedical instrumentation, prentice – hall (India) inc. 2. handbook of biomedical instrumentation R. S. Khandpur, tata McGraw hill pub company Ltd, New Delhi.

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**INE : 414 - BIOMEDICAL INSTRUMENTATION**

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**INE : 415 - DATA COMMUNICATION & NETWORKING**

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ring structures. Fibre optical local area networks, adapting fibre optics to MAP protocols, adapting fibre optics to buses, MAP/ TOP network protocols. Field bus standardisation Smart transmitters- transmission modes, profibus, international field bus standards-intelligent controllers, introduction , model based controllers, predictive control, Artificial intelligent based systems, Expert controllers Fuzzy logic tools, artificial neural networks, neural controllers, neuro-fuzzy control system.


### INE : 416 - ELECTIVE(A) TELEMETRY

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CLASSIFICATION OF TELEMETRY SYSTEMS voltage, current position, frequency, pulse, landline 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 sychors.

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 CIRCUITES FOR MEASURENT 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 out line 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.

**References:** 1.Electrical and electronics measurements and instrumentation, by A.K.Sawhney, Dhanpat Rai & Sons .2.Introduction to Telemetry by Alan Andrews, Foulsham-Sams technical

### INE : 416 - ELECTIVE(B) ARTIFICIAL INTELLIGENCE

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A1 LANGUAGES: important characteristics of A1 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, membership function, rules and algorithms, de-fuzzication and implementation.


### INE : 416 - ELECTIVE (C) ROBOTICS

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**Introduction:** Need for automation, Robotics fundamentals, Classification of Robots (6) based on co-ordinate system, Method of control, Major components of Robotics system, fixed and flexible automation, Application of Robotics.

**Mechanical system:** Components of Robot - Manipulator, Controller, Sensors, Power (8) conversion unit, Fundamentals of Pneumatic, Hydraulic and Electrical actuators used in Robots, Vision systems for Robot.
**Motion conversion:** Rotary to rotary, Rotary to Linear, Linkages, Modeling of (6) Mechanical systems - Translational, Rotational, Kinematics' chain, Lagrangian analysis of manipulator, End effectors, Control of Robotic joints.


**Inverse or back solution:** Problem of obtaining inverse solution, Techniques using (8) direct and geometric approach. Motion generation - On and off line trajectory, Velocity profile, Acceleration profile, Cartesian motion of manipulator, Joint interpolated control, Jacobian in terms of D-H matrix.

**Computer consideration for Robot system:** Robot programming - Fixed instruction (4) sequence control, General programming language, Specific programming languages.

**Artificial intelligence and Robotics:** Artificial intelligence, Real time considerations, (6) Event driven processes and Sensor information processes. Path Planning - Co-ordination motion, Automatic programming.

**Reference Books:**

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### INE : 416 - ELECTIVE(D) FUZZYLOGIC AND NUERAL NETWORKS

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**Motivation [1].**

The role of neural networks in engineering, artificial intelligence, and cognitive modeling.

**Supervised learning in neural networks [4].**

Feed-forward neural networks of increasing complexity, gradient descent learning and extensions, learning and generalization theory

**Computation and dynamical systems [4]**

Hopfield model of content-addressable memory, Hopfield-Tank approach to optimisation, resistive networks for vision models, complex dynamical learning models.

**Reinforcement Learning [4]**

The problem of reinforcement learning, Arp learning, Q-learning, TD-learning. Generalization and function approximation.

**Unsupervised Learning [4]**

Competitive learning, Self-organizing feature maps, ART networks, GWR networks.
Selected Applications [8]

Fuzzy Systems

Textbook:

INE : 421 – FIBER OPTICS & FIBER SENSORS

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Optical Fibers:

Elements of a Optical Fiber Transmission Link, wave guiding. The Nature of Light:

Linear Polarization, Elliptical and Circular Polarization, The quantum Nature of Light.

Basic Optical Laws and Definitions, fiber types, Rays and Modes, Step and Graded Index fiber structure, mode theory for circular wave guides.


Signal Degradation in Optical Waveguides:
Information Capacity Determination, Group delay, Material Dispersion, Waveguide Dispersion, Signal Distortion in signal-Mode fibers, Mode Dispersion and Inter modal Distortion.

Pulse Broadening in Graded-Index waveguides.

Sensors:

Intensity-modulated sensors:
Introduction, Transmissive Concept, reflective Concept, Micro bending Concept, Intrinsic Concept.

Phase-Modulated Sensors:
Introduction and Interferometer Techniques.

Wavelength-Modulated Sensors:
Introduction, Bragg Grating Concept and Bragg Grating Technology.
Temperature Sensors:
Introduction, Reflective concept, Micro bending Concept, Interferometric Concept and Bragg Grating concept.

Pressure Sensors:
Introduction, Transmissive Concept, Micro bending and Intrinsic concepts, Interferometer concepts and Bragg Grating concept.

**Text Books:**
Optical Fiber Communications by Gerd Keiser
Optical Communication Systems by Gower
Optical Communication Systems by Senior
Fiber Optics Sensors B.D.Gupta.

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**INE : 422 – ANALYTICAL INSTRUMENTS**

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ELECTRO-CHEMICAL INSTRUMENTS: electro-chemical cell, construction-potentiometers. conductivity meters- construction-measurement of conductance. polarographs-types of electrodes-instrumentation.

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. Hydrozen 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-nitrozen oxides-hydro carbons-ozone automated wet chemical analyzerswater pollution monitoring.
**INE : 423 - DESIGN OF INSTRUMENT SYSTEMS**

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**References:** DP Eckman-industrial instru