Instrumentation and Electronics Engg. (3-year) B.Tech. Program

First Year First Semester

IEBT/ET/T/111 ELECTRONIC DEVICES

Semiconductor properties, band structure of semiconductors, semiconductor materials, P - N junction creation, width of the depletion region, voltage-current characteristics of diodes, factors affecting the reverse current, transient behaviour.
Transistor fundamentals: Formation of a transistor, current gain, d.c. characteristics, low frequency characteristics, base resistance, power gain, high frequency properties of transistors, transient response of transistors, high current injection.

Field effect transistors - Construction, Characteristics (JFET, MOSFET, Power MOS).

Four layer devices and their characteristics: SCR, DIAC, TRIAC.

Special semiconductor devices: Tunnel diode, CCD, Solar Cell.

IEBT/T/112 CIRCUIT THEORY

Systems Concepts: Causality, linearity and time-invariance, Principle of superposition, Circuit as a system, Integro-differential equation representation, duality.
Passive Elements and Sources: Mathematical representation of ideal resistors, inductors and capacitors, Real or non-ideal passive elements, Ideal independent voltage and current sources, Dependent sources.
DC Circuits: Ohm's law revisited, ohmic and non-ohmic elements, Kirchoff's current and voltage laws, Series and parallel circuits, Maxwell's mesh current method, Node voltage method, Thevenin's theorem, Norton's theorem, Source transformation and its application, Maximum power transfer theorem, Simple circuits using dependent sources.
Sinusoidal Steady-state Analysis: Sinusoid and its transformation to a phasor, Current and voltage phasors in single-element circuits, Simple R-L and R-C series circuits, Concept of reactance, impedance, susceptance and admittance as phasors, Parallel and series-parallel circuits, Apparent, real and reactive power, Power factor, Maxwell's mesh current method and Thevenin's theorem in AC circuits, Series resonance, Bandwidth and Q-factor, Parallel resonance, Mutual inductance and coupled circuits, general two-port networks.
Transients in DC Circuits: Application of Laplace Transforms in circuit theory.

Concept of s-domain variables. Solution of simple R-L, R-C and R-L-C circuits containing dc excitation.
3-Phase Circuits: Generation of a balanced, 3-phase supply and its phasor representation, Phase and line voltages and currents for star- and delta-connected loads, Power and reactive power measurement using two-wattmeter method.

BM/ME/T/A BASICS OF MECHANISMS

Introduction: Mechanism and machine, pairs of element, linkages, degrees of freedom.
Velocity and acceleration analyses of simple mechanisms.
Power transmission devices: belt & pulley, gear, cam & cam follower, clutch, brake.

IEBT/Math/T/114 MATHEMATICS-IK

Functions of complex variables. Limits, continuity and differentiability, Cauchy-Riemann equations.

Analytic functions, Complex Integration, Cauchy's fundamental theorem. Taylor's theorem and Laurent's theorem, Singularity, Pole; Residue, Contour Integration; Conformal transformation. Schwartz Christoffel transformation.

Integral transforms: Laplace transform – properties. Z-transform. Fourier and Hankel Transforms.

Differential equations: Solutions of Legendre and Bessel differential equations. Generating functions. Recurrence relations; Orthogonal property of Legendre polynomial, solution of partial differential equations – wave diffusion and Laplace's equation.

Matrices, Rank, Cayley-Hamilton theorem, their applications.

Elementary statistical theory: Definition of probability. Mean, Median and Mode. Standard deviation. Correlation and regression; Curve fitting from experimental data.

Tensor Algebra : Definition. Covariant and contravariant tensors. Properties, Christoffel symbols. Cartesian tensors.

IEBT/EE/T/115 ELECTRICAL MACHINES-I

DC machine: Construction and principal of operation, armature and field windings, voltage and torque equations, flux and mmf waves, armature reaction and commutation; classification of dc machines; generators; self excitation, characteristics of generators, parallel operation; Motor-different types and the characteristics, starter, speed control, efficiency, loss and tests of DC machines; Dynamic equations, transfer functions and block diagram of DC machine, PM motors,

equivalent circuit of DC machine, testing, Electromagnetic actuating motors.) Transformers - construction, principal of operation, phasor diagram, equivalent circuit, regulation, efficiency and tests, all day efficiency, poly phase transformer connection, auto-transformer.

IEBT/CSE/T/116 NUMERICAL METHODS AND COMPUTER PROGRAMMING

Approximation in numerical computation; Truncation and rounding errors; Numerical solution of a system of linear equations; Matrix Inversion; Iterative methods, Newton Raphson method; Interpolation, numerical integration; Numerical solution of ordinary differential equation; Introduction to Computer system.

Program Logic; Introduction to the programming language C; constants, variables, expressions, iteration and recursion, function, array, scope rules, structure and pointers. Files and file handling.

IEBT/S/111 ELECTRONIC CIRCUITS LABORATORY-I

1. Study of regulated supply, function generator, digital voltmeter and CRO
2. Study of Diode rectifier characteristics: half wave, full wave - without and with filter and with voltage regulator chip: application of p-n and zener diodes
3. Study of Transistor characteristics – CE (detailed), CB and CC
4. Study the transient response of 1st and 2nd order networks: Time domain characteristics
5. Study the transmission characteristics of passive RC and RLC circuits
6. Study the Frequency domain characteristics of Lead lag and Twin-T networks
7. Study of Series and parallel resonance
8. Verification of Thevenin's, Norton's and Maximum Power Theorems
9. Study the firing characteristics of an SCR and other power control devices.

IEBT/CSE/S/112 COMPUTER PROGRAMMING LABORATORY-I

Programming in C: compilation of small programs involving expression evaluation; Usage of control structures; Programs to handle one and two dimensional arrays; Functions; Solving problems related to numerical methods: differential equations; numerical integration and other iterative methods.

BED/ME/S/1 BASIC ENGINEERING DRAWING

Drawing primitives: instruments, letters, lines, title block, geometric curves & shapes, scale and dimension.
Projection: orthographic and isometric, sectional views.

WS/ME/S/10 WORKSHOP PRACTICE-X (Forging and Welding)

Forging: Introduction to forging tools, furnaces and forging machines; to practice basic forging operations- drawing out, upsetting, necking etc.; introduction to forge welding.
Introduction to and practice of different welding processes- gas, SMAW, TIG, MIG, SAW, resistance welding etc.; introduction to gas cutting and its application; soldering, brazing etc.; making welded joints using different welding processes.

First Year Second Semester

IEBT/T/121 FUNDAMENTALS OF INSTRUMENTATION

Basic concept of Instrumentation: functional elements of an instrument, electrical equivalents of mechanical and other systems, classification of systems according to their mode of operation , input-output configurations.
Statistical concept: probability distribution function, chi-square test, curve fitting technique, power spectral density and autocorrelation.
Performance characteristics: static characteristics, loading effects, dynamic characteristics, frequency response analysis, and response of a general form of instrument.
Signal conditioning: signal modulations, deflection bridges, a.c carrier systems.
Errors in measurement: definitions, signals and noise in measurement systems.
Sensing elements: Resistive elements (potentiometer, strain gage, resistance thermometers), Capacitive elements (variable separation, area, dielectric), Inductive elements (variable inductance, potentiometer, variable reluctance, LVDT), magnetic type (eddy current, magnetostrictive, magnetoresistive), Hall devices, Squid.
Piezo electric element, Piezo resistive element.
Thermal transducers: RTD, thermistors, radiation detectors (bolometers, pyroelectric type).

IEBT/ET/T/122 ELECTRONIC CIRCUITS-I

Introduction to diode circuits; Rectifier, Clipper and Clamper; Analysis of full-wave rectifiers; Filters : C and LC.

Introduction to amplifier circuits. Classification of amplifiers - Basic transistor amplifier circuits. Biasing techniques and bias stability. RC-coupled amplifier. Concept of controlled current source and power gain. Simplified hybrid model. Amplifier topologies; Analysis of CE amplifier using simplified hybrid model.

JFET amplifiers, biasing techniques, source follower and common source amplifiers. Bootstrapped amplifiers.

Transistor and FET differential amplifiers.

Regulated power supplies.

IEBT/EE/T/123 ELECTRICAL MACHINES-II

Synchronous machine, construction, induced emf, armature reaction, rotating mmf, vector diagram of synchronous generators and motors, regulation, stability of synchronous machines, parallel operation of generators, efficiency, losses and tests. Induction machine -construction and principal of operation of 3-phase machine, vector diagrams, equivalent circuits torque equations, maximum torque starting and speed control, efficiency and losses, tests, single phase Induction motors, two phase servo motor.

IEBT/EE/T/124 ELECTRICAL MEASUREMENTS

Classification of electrical measuring instruments, general features of indication instruments - controlling, damping and balancing of moving systems; Static and dynamic performance characteristics, Principles of permanent magnet moving coil, moving iron, rectifier, electrodynamic and induction type instruments. Extension of Instrument range - shunt, multipliers, CT., PT., measurement of medium and high resistances, measurement of inductance and capacitance by AC. bridges; D.C. Potentiometers.

IEBT/T/125 DIGITAL ELECTRONICS

Number systems and codes - Position number system, Radix conversion, Different types of BCD, ASCII, EBCDIC, Gray.
Binary Arithmetic - R's and (R-1)'s complement representation,
Subtraction using 1's and 2's complement representation, Concept of overflow, BCD addition.

Fundamental logic operators, Boolean Algebra.

Combinational Logic Design – Definition, Truth Table, SOP and POS realization from truth table, Logic minimization using K-map, Minterms and Maxterms, Minimization with don't care terms, Quine-McClusky's tabular method of logic minimization, Concept of combinational hazard, Examples of combinational logic design : Adder / Subtractor circuits; 2's complement ripple carry adder/subtractor circuit, Parity generator/checker circuit, Circuit for Binary to Gray and Gray to Binary conversion.
Encoder, Decoder, Demultiplexer and Multiplexer,
Function realization using decoder and multiplexer.
Sequential machine design - Concept of Moore and Mealy machine, State transition diagram and State transition table, Various memory elements, NAND-latch and its use, Clocked flip-flops, SR, JK, D, T. Timing constraints on edge triggered flip-flops; Changing one type of Flip-flop to another type, Design of sequence detector. Asynchronous and synchronous counter design. Different types of registers.
Programmable Logic Devices – PROM, PLA, PAL, FPGA.

Integrated Circuit Logic Families - TTL, PMOS, NMOS, CMOS, ECL.

Semiconductor memories - ROM, RAM.

IEBT/IT/T/126 DATA STRUCTURES AND ALGORITHMS

Analysis of Programs: Complexity, Big O notation. Arrays. Queues and Stacks: Linear and Circular Queues, Evaluation of Expressions using Stacks. Linked lists: Singly Linked Lists, Polynomial Addition, Doubly Linked Lists and Dynamic Storage Management, Garbage Collection and Compaction, Strings. Trees & Graphs: Binary Tree - Representations and Traversal Techniques, Threaded Binary Trees, Graph Representation and Traversal Techniques, Shortest Paths.
Searching & Sorting Techniques - Linear and Binary search, Hashing, Internal Sorting Techniques - Bubble Sort, Quick Sort, Heap Sort; External Sorting Techniques - Merge Sort.

IEBT/S/121 DIGITAL ELECTRONICS LABORATORY

Design and verification (both logic as well as timing) of :

1. A simple combinational logic.
2. 8-bit binary to gray and gray to binary code converters.
3. A 4-bit priority encoder.
4. An 8-bit 2's complement adder/subtracter
5. A 4-bit carry look ahead adder
6. A 4-bit multiplier

7. A 4-bit synchronous counter counting in an arbitrary sequence.

8. An 8-bit arbitrary sequence generator.

9. A 4-bit sequence detector. The input to come from a maximal length 10-bit sequence generator.

10. An asynchronous decade counter.

11. An 8-bit serial adder.

12. A 4-bit ALU, which depending on the control word, performs the following:

- 2's complement addition/subtraction
- Bit-wise NOT/OR/AND/NOR/NAND/XOR/XNOR operation.

IEBT/EE/S/122 ELECTRICAL MEASUREMENT LABORATORY

1. Measurement of low resistance by Kelvin Double Bridge.
2. Measurement of high resistance. .
3. Calibration of Ammeter and Voltmeter with D.C. Potentiometer.
4. Measurement of Inductance by Owen's Bridge.
5. Measurement of capacitance by Schering Bridge.
6. Calibration of Wattmeter by D.C. potentiometer.
7. Test of P.T. by absolute technique.

IEBT/EE/S/123 ELECTRICAL MACHINES LABORATORY

1. EMF Induced In DC Machine
2. External Characteristics of DC shunt/compound Motor- study relations between speed, fleldcurrent and armature voltage.
3. Brake test of a DC series motor.
4. Coil connection of a single phase transformer.
5. OC and SC of a single phase transformer and determination of loss, efficiency and

regulation.
6. Starting and load characteristics of a 3-phase Induction Motor.

WS/ME/S/11 WORKSHOP PRACTICE-XI

(Fitter Shop and Machine Shop)

Introduction to fitter's tools, gauges, measuring instruments etc.; marking of jobs; fitter's job involving chipping, filing, sawing, drilling; use of taps and dies; pipe fittings and plumbing.
Introduction to machine tools - lathes, drilling machines, shaping machines, planning machines, slotting machines, milling machines, grinding machines; machine shop work involving different operations by using the above mentioned machines through making of jobs.

Second Year First Semester

IEBT/T/211 ELECTRONIC CIRCUITS-II

Types and classification of amplifiers (e.g. modes of operation Class A, Class B, Class C Class D etc. amplifiers), Frequency response of small signal amplifiers, Power amplifiers, push-pull, complementary symmetry, quasi-complimentary symmetry.

Principle of operation of feedback amplifiers and their analysis and characteristics for voltage feedback and current feedback types.
Oscillator: Criterion for oscillation, RC oscillator - phase shift and Wien Bridge oscillator, LC oscillators - Hartley, Colpitt and tuned circuits, Relaxation oscillator, Multivibrator circuits.

IEBT/T/212 ANALOG INTEGRATED CIRCUITS

Operational Amplifier Fundamentals: Amplifier Fundamentals, The Operational Amplifier, Op-Amp Characteristics. Op-Amp in open loop comparator mode, Different applications

Linear Op-Amp Circuits: Basic Op-Amp Circuits, V-I Converter with floating and grounded load, Current amplifier, Difference amplifier, Instrumentation amplifier, Analysis of some typical Op-Amp circuits.

Non-linear Op-Amp Circuits: Schmitt trigger and applications, Precision rectifiers, Analog switches, Peak detectors, S/H circuits.

Practical Op-Amp limitations: D.C errors, Slew rate, Frequency response, Noise effect, Frequency compensation., Ideal and Practical Integrators, Differentiators and solution of differential equations. Active filters: Butterworth and Chebyshev.

Generalized Impedance Converter and RLC ladder simulation design.

Multivibrators : Astable, Monostable.

Signal Generators: Wien bridge oscillator, Triangular wave generator, Sawtooth wave generator.

Integrated Circuit Timer 555 and its applications

Log/Antilog Amplifiers, Analog Multipliers and their applications.

Analogue to Digital Converters: Successive Approximation type, Dual Slope Integrator type and Flash type. Digital to Analog Converters. IC Voltage regulators. Introduction to Switched-Capacitor Circuits.

IEBT/T/213 PROCESS INSTRUMENTATION-I

Industrial Weighing systems**:** Various types of strain gauge, load cells-column type, shear type and bending beam type, pressductor, application consideration of load cells, introduction to belt conveyor weighing systems and weighfeeders.

Measurement of velocity and acceleration: Tachogenerators, tachometers, stroboscopes, encoders, non contact rpm measurement techniques, seismic accelerometers- piezoelectric, piezoresistive and capacitive types.

Proximity sensors**:** Inductive, optical, magnetic, capacitive and ultrasonic.

Pneumatic systems**:** Flapper-nozzle assembly, pneumatic relay, air filter regulator, pneumatic force balance systems, pneumatic transmitters.

Introduction to electronic transmitters.

Hardware /software sensor linearization techniques, concept of galvanic isolation.

Measurement of pressure and vacuum**:** Review of measurement principles, manometers, elastic pressure sensors - bourdon tube, bellows, diaphragm and capsule, bourdon tube pressure gauge, pressure switch, electronic pressure transmitters - capacitive, piezo-resistive and resonator type, installation of pressure measuring devices, accessories for pressure measurement - chemical seal and snubbers. Vacuum measurement using Mcleod gauge, thermal conductivity gauge, ionization gauge.

Torque measurement in rotating shafts. Introduction to vibration measurement and monitoring.

IEBT/T/214 LINEAR CONTROL SYSTEMS

Introduction: Control systems, Physical elements of a control system, Abstract elements of a control system, The design process.
Mathematical Model of Physical Systems: Introduction, Differential equation representation of physical systems, Transfer function concepts, Block diagram algebra, Signal flow graphs, Concepts of state, state variables and state model, State models of linear continuous-time systems, Concept on Controllability and Observability, Illustrative examples.

Feedback Characteristics of Control Systems: Introduction, Reduction of parameter variation by use of feedback, Control of system dynamics by use of feedback, Control of effects of disturbance signals by use of feedback, Regenerative feedback, Illustrative examples.
Control System Components: Introduction, DC servomotors, DC tacho-generators, AC servomotors, AC tacho-generators, Stepper motors, Synchro error detectors, Areas of Application.
Time Response Analysis: Introduction, Standard test signals, Performance indices, Time response of first order system, Time response of second order systems, Design specifications of second order systems, Compensation schemes, Design specifications of higher order systems.

Stability Analysis in Time Domain: The concept of stability, Assessment of stability from pole positions, Necessary conditions for stability, Routh Stability Criterion, Relative stability analysis, Illustrative examples.

Root Locus Technique : Introduction, The root locus concept, Root locus construction rules, Root

contours, Case studies.

Frequency Response Analysis: Introduction, Performance indices, Frequency response of second order systems, Polar plots, Bode plots, All pass systems, Minimum-phase and Non-minimum-phase systems, Illustrative examples.

Stability Analysis in Frequency Domain: Introduction, A brief review of Principle of Argument, Nyquist stability criterion, Assessment of relative stability – Gain Margin and Phase Margin, Closed loop frequency response, Illustrative examples.
Introduction to Design: The design problem, Concepts of cascade and feedback compensation, Realization of basic compensators, Case studies.

IEBT/ET/T/215 SIGNAL PROCESSING AND TRANSMISSION

Signals: Representation of signals; Generalized periodic waveforms, trigonometric and exponential Fourier series, Fourier transform, Convolution, Correlation, Energy and power spectral densities.

Transmission Line: Parameters. Theory of transmission line - General solution, lumped and distributed parameters, the infinite line, propagation velocity, waveform distortion, distortion less line, reflections, insertion loss, equivalent sections, terminations, characteristic impedance and matching.

Modulation: Amplitude modulation - representation, frequency spectrum, power relations; Generation of AM, linear and nonlinear modulation; Single sideband (SSB) techniques - generation, carrier suppression, suppression of unwanted sideband, extensions of SSB, pilot carrier systems, vestigial sideband transmission. Frequency modulation - Theory of FM and PM, Generation of FM, Pre-emphasis and de-emphasis, Circuit schemes and comparisons, VCO's - circuits and applications.

Transmitters and receivers: AM and FM transmitters - basic characteristics and comparisons, different transmitter types; Receivers - Super heterodyne types; AM receivers - Frequency changing and tracking, Mixers and converters, Detection and AGC, communication receivers; FM-receivers - common schemes, comparison with AM types, Amplitude limiting, different demodulator/detector circuits.

IEBT/T/216 MICROPROCESSORS –THEORY & APPLICATIONS

Introduction: Block diagram of a Computer system - Central Processing Unit (CPU), Memory, Input/Output (I/O) Ports, Address, Data and Control Buses, Evolution of microprocessors – the Intel and Motorola variants, Microprocessors as the CPU of computer systems.

The 8085 family of microprocessors:

Hardware Overview: Internal architecture, Address bus, Data bus and Control bus, Clocking, Reset operation, Status pins.

Memory Management: The von Neumann architecture, Partitioning of the available memory space into program memory, data memory and memory-mapped devices, Planning for building up a microprocessor board.

Programming the 8085: Introduction to microprocessor programming paradigm, Assemblers, Linkers, Loaders and Cross-compilers. Assembly language Programming - Instruction format, Instruction set. Use of flowcharts to build-up simple programs, Stack and Stack handling, Programming exercises.

Timing Diagrams: Instruction cycle, machine cycle, T-states. Analysis of Memory and I/O read/write cycles. Generic state transition diagram.

Interrupts: Introduction, Interrupt vector table, Interrupt service routine, Interrupt timing. Design of programs using interrupts.

Data Transfer Schemes & Interfacing: Serial and parallel data transfer schemes, Polling and interrupt driven data transfer, Direct memory access, Interfacing input-output ports, Programmable peripheral devices (PPI), Programmable interval timer; Interfacing A/D and D/A converters.

Introduction to the 8086 family of microprocessors:

Hardware Overview, Programming the 8086, Overview of the 8086 maximum mode operation, Working with the 8087 math co-processor.

Brief review of 8086 family upgrades.

IEBT/S/211 ELECTRONIC CIRCUITS LABORATORY-II

1. Study of different amplifier configurations and the corresponding frequency responses for an RC-coupled amplifier with BJT/FET.
2. Study of parameters of practical op-amp.
3. Use of op-amps- Non-inverting and Inverting amplifier, buffer, adder, subtractor.
4. Differentiators, Integrators.
5. Multivibrators using op-amps.
6. Astable & monostable multivibrators using IC 555.
7. Wien Bridge Oscillators.
8. Study of precision rectifiers.
9. Triangular Wave Generator.
10. Design of Active filters.

IEBT/S/212 CONTROL ENGINEERING LABORATORY

1. Study of A DC Position Control System
2. Study of An AC Position Control System

3. Study of A Stepper Motor and its Translator
4. Study of A Feedback Illumination Control System
5. Study of A Variable-voltage, Variable-Frequency Speed Control System for An Induction Motor
6. Identification of the 2nd-order Model of a Linear System from Step Response Test
7. Simulation Study on Effects of Compensation Networks

IEBT/IT/S/213 COMPUTER PROGRAMMING LABORATORY-II

Programming the problems for implementing abstract data types like stacks, queues, linked lists etc. Solving recursive algorithms, sorting, searching, pattern matching etc.

IEBT/S/214 PROCESS INSTRUMENTATION LABORATORY

1. Familiarization with symbols and terminology of P&I diagrams and drawing P&I diagrams using AutoCAD.
2. Study of the characteristics of LVDT, phase sensitive detector and Synchronous detector.
3. Design and construction of a two-wire V-I transmitter and evaluation of its characteristics.
4. Measurement of RPM using stroboscope, incremental encoders, proximity sensors and study of an absolute encoder as an angular position sensor.
5. Calibration of a load cell using standard weights and development of associated electronics to construct a weighing system.
6. Study and configuration of a Smart Differential Pressure transmitter.
7. Study of a semiconductor / piezoelectric accelerometer and its application to vibration monitoring.
8. Calibration of pressure gauge, pressure switch, analog pressure transmitter using pneumatic calibrator / dead weight tester.

Second Year Second Semester

IEBT/IT/T/221 OBJECT ORIENTED PROGRAMMING

Introduction to Programming Paradigms - Logic, Functional, Procedural and Object Oriented, Differences of OOP vis-à-vis other programming paradigms, history of OOP languages, brief introduction to OOP terminology - Class and Object, Encapsulation and Abstraction, Information Hiding, Polymorphism, Inheritance, Function Overloading, Static & Dynamic Binding

Brief Overview on C++ - functions and function overloading, reference, inline functions.

Classes - user defined types, instance variables, member functions, constructors, destructors, operators, access rules, this pointer, scope of variables, dynamic memory management

Class Relationships - association, aggregation, composition, inheritance, Abstract classes, polymerphism, dynamic binding.

C++ Features: Friends, Multiple inheritance, Virtual base class.

Exception handling.

File Handling and I/O operations in C++

Advanced C++ concepts – function templates and class templates, namespace, advanced cast operators – static_cast, dynamic_cast, reinterpret_cast, const_cast, typeid operator, concepts of Standard Template Library (STL)

Object oriented design and modeling – overview, software engineering perspective of software development, the desirable qualities of software systems, software architecture concepts, software process life cycle, object oriented process, need and methodology of oo modeling perspectives, object oriented design patterns

Java – overview and basic concepts, JVM, code once run anywhere model, memory allocation and automatic garbage collection, differences from C++, advantages and disadvantages, class and object, message passing, encapsulation, polymorphism, aggregation, threading, inheritance, dynamic binding, applet programming.

IEBT/T/222 PROCESS CONTROL-I

The basic process control loop- different blocks in the loop.

Process Equations - their limitations, scale modeling, typical processes and their transfer function deviations, Processing modeling techniques.

Effect of disturbances and set-point variations in the loop transfer functions, Review of system response with standard inputs, offset, Process Reaction Curves, Controllability using deviation reduction factor, Gain band product and state variable formulation, Stability - review, Self-regulation.

Schemes and analysis of on-off control, Time-proportional control, P,I,D controls, Control action comparison, Pneumatic adjustment, Pneumatic, Electrical/Electronic and Hydraulic controllers, Introduction to programmable logic controllers.

Schemes and analysis of Split-Range control, Ratio control, Cascade control, Feedforward control, Selector control, Antireset control, Introduction to Multivariable control systems. Control of flow, level, temperature and pressure.

Final control elements, The pneumatic actuator and control valves, Sizing and selection of control valves, Linearisation, Positioners, Electrical actuators and their driver circuits, P-I and I-P converters. Safety valves and other associated components.

Introduction to Computer Control of Processes. Elements in a digital control loop, A simple case study. Intoduction to digital control algorithm.

Discussions on control of specific plants like boilers, distillation column, paper plant, steel plant, power plant etc. Control of batch processes.

Introduction to DCS and OCS.

IEBT/T/223 PROCESS INSTRUMENTATION-II

Instrumentation in Hazardous locations: Area, material & temperature classification. Explosion proof enclosures, intrinsic safety, pressurization, non incendive systems. Combustible gas detectors. Enclosure classification - IP & NEMA standards.

Temperature measurement: Temperature scales, ITS90, temperature calibrators and simulators, thermowell. Different types of thermometers: liquid in glass, bimetal, filled system, thermocouple, RTD, thermistors, IC temperature sensors, radiation thermometers, temperature switches, thermostats.

Level measurement: Review of different level measurement methods and application considerations. Various level measurement devices: gauge glass, float & displacer type level sensors, D/P type level sensors, capacitive level sensors, ultrasonic & microwave level sensors, tape level gauges, servo level

gauges, hydrostatic tank gauging systems, conductivity level sensors, radiation level sensors, vibrating level switches.

Flow measurement: Fluid properties, turbulent & laminar flow, Reynolds number, velocity profile, flow conditioners, influence of pressure & temperature on volume flow-rate, flow computers, totalization, flow calibration. Different flow measurement techniques: differential pressure flowmeters, variable area flowmeters, magnetic flowmeter, mass flowmeter - coriolis & thermal types, vortex shedding flowmeter, positive displacement flowmeter, positive displacement flowmeter, turbine flowmeter, ultrasonic flowmeter, target flowmeter, insertion flowmeter, open channel flow measurement, measurement of flow of bulk solids. Criteria for selection of flowmeters.

Smart transmitters - features & advantages, HART protocol.

Overview of sensor- actuator networks, field bus.

IEBT/T/224 DIGITAL SIGNAL PROCESSING

Description of Signals and Systems: Types of signals and their characteristics, types of systems and their behavior.

Discrete-time description of signals: Discrete-time sequences, their frequency domain behaviour, comparison with analog signals, convolution of two sequences, sampling a continuous function to generate a sequence, reconstruction of continuous-time signals from discrete-time sequences.

Discrete-time description of systems: Unit-sample response of a system, Time-invariant systems, Superposition principle for linear systems, Stability criterion for discrete-time systems, Causality criterion for discrete-time systems, Linear constant-coefficient difference equations.

Discrete-time Fourier transform: Definition of Fourier transform (FT), important properties of FT, properties of FT for real-valued sequences, use of FT in signal processing, FT of special sequences, the inverse FT, FT of the product two discrete-time sequences, program to evaluate the FT by computer.

Discrete Fourier Transform: The definition of the Discrete Fourier Transform (DFT), computation of the DFT from the discrete-time sequence, properties of the DFT, circular convolution, performing a linear convolution with the DFT, computations for evaluating the DFT, programming the DFT, increasing the

computational speed of the DFT, intuitive explanation for the decimation-in-time FFT algorithm, analytic derivation of the decimation-in-time FFT algorithm, some general observations about the FFT.

Z-transform: Definition of the z-transform, properties of the z-transform, the system function of a digital filter, combining filter sections to form more complex filters, digital filter implementation from the system function, the complex z-plane, the region of convergence in the z-plane, determining the filter coefficients from the singularity locations, geometric evaluation of the z-transform in the z-plane, relationship between the Fourier transform and the z-transform, the z-transform of symmetric sequences, the inverse z-transform.

Digital filter: Definition and anatomy of a digital filter, frequency domain description of signals and systems, typical applications of digital filters, replacing analog filters with digital filters, filter categories: IIR and FIR, recursive and non-recursive.

Digital Filter Structures: The direct form I and II structures, Cascade combination of second-order sections, parallel combination of second-order sections, Linear-phase FIR filter structures, Frequency-sampling structure for the FIR filter.

Effect of word length: Round off error, truncation error, qunatization error, limit cycle.

IEBT/T/225 MICROCONTROLLERS – THEORY AND APPLICATIONS

Introduction to Microcontrollers: From microprocessors to microcontrollers – changes in hardware architecture, instruction set and applications.

MCS-51 Hardware Overview: Functional block diagram with pin description, I/O port structure, Memory Organization, Special Function Registers, External Memory options, Reset operation.

Instruction Set: Introduction, Addressing Modes, and Instruction Types.

Timer Operation: Introduction, Timer Mode and Timer Control Registers, Different modes of operation, Clocking sources, Controlling the timer, Illustrative examples.

Serial Port Operation: Introduction, Serial Port Control Registers, Modes of operation, Serial Port Baud Rates, Multiprocessor Communication, Illustrative examples.

Interrupts: Interrupt Organization, Processing interrupts, Program design using interrupts, Interrupt timing.

Assembly Language Programming: Program Format, Assembler Directives, Macros, Linker operation.

Design & Interface Examples: Interfacing a 12-bit A/D converter, Interfacing a Real Time Clock IC, Interfacing multiple 7-segment LEDs, Interfacing a hexadecimal keypad.

Case Study: Design of an 8-channel Temperature Scanner.

IEBT/IT/T/226 COMPUTER ORGANIZATION AND NETWORKING

Processor Design : Processor Organisation, Instruction Set, Design of ALU.

Control Design : Hardware and Microprogrammed Control Units.

Memory Design : Interleaved memory, Cache, Associative Memories, Virtual Memory, Paging and Address Translation.

Operating Systems : Evolution, Memory and Processor Management, File System, Access and Allocation methods, Protection.

Parallel Processing : Introduction, Principles of Pipelining and Vector Processing, SIMD and MIMD Models of Computation.

Computer Networks: Introduction, ISO's OSI reference model, Switching Methods, CCITT (ITU) standards, Data Link Protocols, Routing and Flow Control, Access methods and Protocols, LAN, Bus and Ring Networks, IEEE Standards, TCP/IP Standards - Internet Services and Intranet.

IEBT/S/221 PROCESS CONTROL LABORATORY

1. Study of zener barrier / isolating interface and their use for the construction of an intrinsically safe measurement system.
2. Study of the features of a coriolis mass flowmeter / electromagnetic flowmeter.
3. Development of ladder diagrams and its use for interlocking & sequence control using a PLC.
4. Development of a PC based Human Machine interface for a PLC based control system.
5. Interfacing a PC based controller with a level control rig and study of On-Off / P /PI control modes.
6. Study of a Distributed Control System.
7. Study of a control valve with and without a positioner.
8. Calibration of temperature sensors, temperature switch, analog temperature transmitter and a μP based temperature indicator.

9. Study and configuration of a Smart temperature transmitter.

IEBT/IT/S/222 ADVANCED PROGRAMMING LABORATORY

1. Assignment on usage of Compilation, Linking and usage of IDE using C++
2. Assignment on C++ declarations and expressions
3. Assignment on C++ enumerations and constness
4. Assignment on C++ array, pointer and structure
5. Assignment on C++ functions and parameter passing by value and reference
6. Assignment on C++ classes with constructors, destructors, copy constructors, variations of access rules – private, protected and public, usage of this pointer, usage of scope of variables, dynamic memory management
7. Assignment on C++ Operator Overloading for unary operators, binary operators, subscript and function operator, cast operator, increment and decrement operators, new and delete operators, extraction and insertion operators
8. Assignment on single, multiple and multilevel inheritance, constructor and destructor calling sequence, virtual base classes, friend, virtual function and dynamic binding, abstract class and pure virtual function, overriding and hiding
9. Assignment on file handling and I/O operations in C++
10. Assignment on C++ templates – function and class templates, namespace, exception handling
11. Assignment on STL in C++
12. Assignment on fundamental data structures and algorithms in C++ - arrays, linked lists, stacks and queues, trees, searching and sorting - naive search, binary search, bubble sort, insertion sort, merge sort, quicksort
13. Assignment creating and accessing packages, classes, inheritance in Java
14. Assignment on Java multithreading and applet programming

IEBT/S/223 MICROPROCESSOR AND MICROCONTROLLER LABORATORY

1. Elementary program practice using 8085 microprocessor.
2. Design for interfacing with PPI.
3. Experimental verification of different operating modes of the programmable timer Intel 8253.
4. Stepper motor control - Half-step and Full-step methods.
5. A.C Power control using (I) Programmable timer - Intel 8253 and (ii) PPI - Intel 8255.
6. Interfacing A/D and D/A converters.
7. Linearising transducer characteristics using table look-up method.
8. Measurement of frequency and time period using microprocessor.

Programming practice using 8051 microcontroller.

1. Generating two pulse trains in quadrature.
2. Implementing a real time clock on the microcontroller.
3. Exchanging data with a PC through the on-chip serial port.

IEBT/S/224 SEMINAR

Each student will give a technical presentation on a topic that relates to the course curricula, preferably on recent technological advances or current developments.

Third Year First Semester

IEBT/T/311 ELECTRONIC INSTRUMENTATION

Building blocks of Electronic Instruments: Voltage controlled oscillators, Phase Locked Loop, Charge Amplifier, Programmable Gain Amplifier, Current Mirror, Voltage to frequency and frequency to voltage converters.
Analogue Electronic Instruments: Introduction, Basic Emitter Follower Voltmeter, Voltmeters with IC Operational Amplifiers, True R.M.S Voltmeter, Peak Response Voltmeter.
Electronic Ohmmeters.
Current measurement with Analogue Electronic Instruments – Current-to-voltage converter type Electronic Ammeters, Chopper stabilized amplifiers for measurement of very low voltages and currents.
Electronic Measurement of Power.
Cathode ray oscilloscopes: Cathode Ray Tube, Deflection Amplifiers, Oscilloscope Time Base, Dual-Trace Oscilloscopes, Oscilloscope Controls, Oscilloscope Probes, Delayed time base oscilloscope, Digital Storage Oscilloscope.
Digital instruments: Introduction, Basic Digital Displays – LEDs and LCD panels. Display Drivers and Latches, Time Base generation with Crystal Oscillators and Dividers.

Design and Implementation of a simple Digital Frequency Meter, Errors in frequency measurement – possible remedies, Time and Ratio measurement.
Digital Voltmeters.
Arbitrary Waveform Generation.
Microprocessor Based Instrumentation – A Case Study.
Spectrum Analyzer.
Introduction to Virtual Instrumentation.
Interference and Noises.

IEBT/T/312 PROCESS CONTROL II

Sampled-data control system: Digital Computer as a controller in process control loop, advantages and disadvantages of sampled-data control systems, discrete time signal, sampling of continuous signal, signal reconstruction, z-transform, difference equation and z-transform, pulse transfer function, analysis of SISO process control loop by z-transform technique, z-and s-domain relationship, stability analysis of discrete systems in z-plane, stability analysis by using Bilinear transformation, Jury's stability test, steady-state error analysis of sampled-data control systems, Digital implementation of PID controller, Digital control algorithms - controller design by transformation from s-domain to z-domain, deadbeat control, Dahlin's technique, Kalman's algorithm.

Distributed Control System: Architecture and loop elements, networks, gateways and connectivity, proprietary software protocol, redundancy, interfacing units, operating stations.

Case study: Enhanced boiler drum level control.

Programmable Logic Controller: Architecture, Programming, Application case study.

Multivariable control system: Loop interaction, Pairing controlled and manipulated variables, Design and tuning of Decouplers, Tuning multivariable control systems.

Adaptive and Self-tuning control: Need for adaptive control, adaptive control by preset compensation, adaptive control by pattern recognition, adaptive control by discrete parameter estimation.

Dead time compensation - Smith predictor and Dahlin controller.

Fuzzy control: Fuzzy set, Membership function, Fuzzy relation, Fuzzy Proposition, Structure of Fuzzy Rules, Fuzzy inference, Fuzzy logic controller (FLC) – block diagram and computational steps, PI-, PD-, and PID-type FLCs, Rule-base design, Tuning of FLC parameters, Merits and limitations of FLCs, Examples of FLCs in industries.

Neuro-fuzzy control: Models of a neuron, Multilayer feedforward networks – architecture and learning, Models of neuro-fuzzy control systems and computational steps.

Process Control Systems – case studies:

(1) Control of distillation column.

(2) Control of cement production.

IEBT/T/313 POWER ELECTRONICS

Power Semiconductor Devices: Rectifier diodes, fast recovery diode and Schottky barrier diode. Power BJT and power Darlington transistors, Power MOSFET. The thyristor family: SCR, triac, inverter-grade SCR, asymmetric SCR, reverse-conducting thyristor (RCT) and gate turn-off thyristor (GTO). SCR turn-on and turn-off methods. Insulated gate bipolar transistor (IGBT). Common triggering devices and their applications: UJT, diac and PUT.
Phase-controlled Rectification and Inversion : Single-phase converter circuits. Polyphase converters: delayed commutation and commutation overlap, phase-controlled inverter, reactive power and power factor, free-wheeling operation, three-phase full-wave bridge converter, half-controlled bridge converter, regenerative converters. Introduction to DC motor speed control.
Variable-frequency Conversion: The DC link converter, voltage control methods, forced commutation techniques, frequency control, the six-stepped three-phase inverter.

Introduction to AC motor speed control.

Industrial Heating and Welding: Induction heating and dielectric heating principles and Inverters for these applications.

Arc welding and resistance welding principles. Solid-state control of welding process.

Switched mode power supplies, Uninterruptible power supplies.

IEBT/T/314 OPTICAL INSTRUMENTS AND OPTO-ELECTRONICS

Introduction –wave, particle duality, EM spectrum, definitions. Radiometry: implications, radiometric to photometric conversion

Laws of black body radiation, Planck's law, Wien displacement, Stefan's law, radiation and optical pyrometry

Fresnel reflection and refraction, polarization

Interferometers

Diffraction

Geometrical optics

Refractive index, optical path, Fermat's principle, image formations, wavefront concept- Huygen's principle, laws of reflection and refraction-proofs

image formation- plane, curved, refracting surface – vergence, refractive power, Gaussian & Newtonian formula for single refracting surface, simple lenses, mirrors – tabular form

primary aberrations

resolution limit, eye, camera, film- aperture, stops, pupil

simple magnifier, microscope, telescope, projection systems – NA, profile projector

filters, prisms- dispersion, types of prisms, Abbé refractometer

gratings, monochromator, spectrophotometer

Optoelectronics

Incandescent lamps, LED

LDR, silicon cell, photodiode – PV, PC modes, PIN, APD

Optrons (optoisolators, optocouplers) – components, source-detector characteristics, V-I, energy, spectral characteristics, noise- thermal, shot noise, NEP, noise figures for PD, PIN and APD

PMT, CCD, Schottky PD, Heterojunction PD

Lasers

Spontaneous, stimulated emissions and absorptions, Einstein's assumptions, population inversion, 3-level, 4-level – metastable state, block diagram- power supply, pumps

Active medium- gain, resonant cavity-types, modes, characteristics

Types- gas, liquid, solid, semiconductor lasers – details

Fiber optics, Holography .

IEBT/T/315 ELECTIVE-I

1. POWER PLANT INSTRUMENTATION

2. OPERATING SYSTEMS

3. AI AND EXPERT SYSTEMS

4. SENSOR TECHNOLOGY

5. DIGITAL SYSTEM DESIGN USING VHDL

6. NON-LINEAR CONTROL THEORY

7. ELECTRONIC OLFACTION

IEBT/T/315A POWER PLANT INSTRUMENTATION

General concepts of different power plant setups and energy conversion process. Thermal power plant instrumentation –controlling, monitoring and testing of boilers, turbines, condensers, generators, coal-handling units and auxiliary systems, quality monitoring of air water and exhaust gas. Salient features of instrumentation in nuclear, hydroelectric and non-conventional power plants. Instrumentation for safety-interlocks, protective devices; emergency measures; alarms and alarm analysis, monitoring of environmental pollution. Data-handling systems-data acquisition, processing, accounting, logging and display-storage systems. Introduction to power plant simulators.

IEBT/T/315B OPERATING SYSTEMS

Surface feature inspection and testing: General, visual, chemical, mechanical. Optical - Laser probe, holography, ultrasonic surface wave probing, Magnetic - magnetisation, flux, electropotential, electrical resistivity, Electro-magnetic - eddy current techniques, penetrant, radiation backscatter etc.

Sub-surface (Internal feature inspection and testing): Thermal - temperature sensing, Electrical resistivity, Ultrasonic - longitudinal refraction/diffraction and fluorescence, Gamma rays - radiography. IQI (Image Quality Indicator), Xerography, Image Intensification methods, Electron microscopic techniques, ISO specifications and other certifications.

IEBT/T/315C AI AND EXPERT SYSTEMS

AI: Introduction to the AI Programme. What is AI? - The roots, the goals, the subfields. Cognitivism and the birth of AI. Biological Intelligence - Neural Network Systems. Brain Modelling and Experimental Testing. Building Intelligent Agents. Evolutionary Computation. Knowledge Representation I – Foundations. AI Application – Vision. Knowledge Representation II - Semantic Networks. Knowledge Representation II – Frames. AI Application – Robotics. Production Systems - Recognize-Act-Cycle, Matching, Conflict Resolution.

Expert Systems: Introduction to expert systems. Introduction to an expert systems tool. Inference engine. Search methods, backward chaining, forward chaining. Constructing an expert system, knowledge engineering. Dealing with uncertainty. Fuzzy Systems - Introduction to fuzzy systems,

Fuzzy sets, Fuzzy operators, Fuzzy reasoning: fuzzification, inferencing, defuzzification. Automated Knowledge Acquisition - Introduction to automated knowledge acquisition. An overview of induction methods. An introduction to the theory and use of an induction method.

IEBT/T/315D SENSOR TECHNOLOGY

Sensing principles, sensor types and classification - mechanical, acoustic, magnetic, thermal, chemical, radiation; micro sensors; sensors based on surface-acoustic wave devices. Micro machining techniques-bulk, surface and other micro machining methods; microelectronics compatible sensors technology; principles of design, fabrication and characterization of miniature sensors. MEMS for automotive, communication and signal processing applications; modeling and simulation of micro sensors and actuators; micro electro-mechanical / electro-optical sensors and systems.
Film sensors- thick film and thin film types. Electro analytic sensors – Electrochemical cell, Polarization types, membrane electrode types, electro ceramic type and chemFET. Biosensors.

Smart/Intelligent sensors, sensor arrays and networks. Nano-sensors, adaptation of scanning tunneling microscopy and atomic force microscopy for realization. Nano-tube sensors, molecular and quantum sensors.

IEBT/T/315E DIGITAL SYSTEM DESIGN USING VHDL

Review of Combinational Logic and Sequential State Machine designs.

Concepts of Digital System Design Process, Design automation, Hardware Description Language, Hardware Simulation, Oblivious Simulation, Event-driven simulation, Hardware synthesis, Level of abstraction.

VHDL Language, Design methodology based on VHDL, Elements of VHDL, Describing components, Packages, Top down design, verification, Top-down design with VHDL, Subprograms, VHDL operators, Conventions & Syntax.
Basic concept in VHDL: Characterizing Hardware Language, Timing, Concurrency, Hardware modeling, Objects & Classes, Signal assignment, Inertial delay, Mechanism, Transport delay mechanism, Comparing Inertial and Transport.

Concurrent and Sequential Assignment: concurrent assignment, Event and Transaction, Delta delay, Sequential placement of transaction.

Type declaration and usage, Enumeration type for multi value logic, Array declaration, VHDL Operators, subprogram parameters, Types and overloading, Array attributes, Type attributes, Signal attributes, Entity attributes.

Sequential processing : Process statement, Signal assignment versus Variable assignment, Sequential statements – IF, CASE, LOOP, ASSERT, WAIT etc., Concurrent assignment problem, Passive processes.

Structural Specification of Hardware: Inverter model, NAND gate model, Logic Design of Comparator, VHDL description of comparator, VHDL description of a simple test-bench, simulation, Logic design of Latch, Flip-flop, Counter and Registers.

Subprograms and Packages : Subprograms, Functions, Conversion functions, Resolution functions, Procedures. Packages, Package declaration, Deferred constants, Subprogram declarations, Package body.

Aliases, Qualified expressions, User-defined attributes, Generate statements, Text I/O.

Data flow Description in VHDL: Multiplexing and data selection, General Multiplexing, Guarded signal assignments, Block Declaration Parameters, Resolving between several driving values.

State machine description, A sequence detector, Allowing multiple active states, Mealy and Moore machine, Generic State Machine, General data flow circuits.

Design configurations: Default configurations, Component configurations, Mapping library entities, Generics in configurations, Architecture configurations.

Synthesis: RTL description, Constraints, Attributes, Technology libraries, Translation, Optimization, Flattening, Factoring, Mapping to Gates.

System Design – a case study: Design and synthesis of a typical CPU.

ASIC Design Methodologies and CAD Tools. Design automation and classes of design tools. Implementation approaches. CPLDs and FPGAs. IP cores. System-on-a-chip.

IEBT/T/315F NON-LINEAR CONTROL THEORY

Describing function, phase-plane analysis. Poincare's Index, Bendixson's theorem. Linearization. Lyapunov stability, stability theorems, variable-gradient technique and Krasovskii's method for generating Lyapunov functions, statement of Lur'e problem, circle criterion, Popov criterion, input-output stability.

IEBT/T/315G ELECTRONIC OLFACTION

Introduction to human olfaction: Nasal chemosensory detection, Thresholds for odour and nasal pungency, Psychometric functions for odour and nasal pungency, Olfactometry – Static and dynamic, Environmental chambers.
Instruments for chemical sensing – Gas Chromatography - Olfactometry.
Odour handling and delivery system: Physics of evaporation, Sample flow system, Headspace sampling, Diffusion method, Permeation method, Bubbler, Sampling Bag method, Preconcentrator.

Sensors for olfaction: Survey and classification of chemosensors, Chemoresistors, MOS, Organic Conducting Polymers, Chemocapacitors, QCM, SAW, Optical odour sensors.

Signal conditioning and pre-processing: Interface circuits, Baseline manipulation, Normalization, Noise in sensors and circuits.

Pattern recognition methods: Nature of sensor array data, Classification of analysis techniques. Statistical pattern analysis techniques: Linear Discriminant analysis, Principal component analysis, Cluster analysis.

Intelligent Pattern Analysis Methods: Multilayer feedforward networks, Competitive feature mapping networks, Fuzzy based pattern analysis, Neuro fuzzy systems.

Integrated Electronic Noses and Microsystems for Chemical Analysis: Microcomponents for fluid handling, Microchannels and mixing chambers, Microvalves, Micropumps, Integrated E-Nose systems.

IEBT/S/311 IC APPLICATIONS LABORATORY

1. Study of IC voltage regulators.
2. Study of a Frequency to Voltage converter.
3. Study of a Voltage to Frequency converter.
4. Study of a Pulse Width Modulator.
5. Study of a 2-digit BCD Up-counter.
6. Study of a 3-bit Flash type A/D converter.
7. Use of PLL for frequency multiplication.

IEBT/S/312 SIGNAL PROCESSING LABORATORY

1. MATLAB Review, Sequences, Operations with sequences, Linear Convolution, Synthesis of Sinusoidal Signals, The Sound Command, Multiplication of Sinusoids: Beat Notes, Amplitude Modulation.
2. Introduction to the DFT, The DFT of a rectangular window, The effect of zero padding a sequence on its spectral profile, Spectrum replication, The DFT of a signal that is the sum of sinusoids, The DFT of an AM waveform, The frequency axis in terms of the index k, w[rad/samp] and f[Hertzs], Aliasing, A simple low pass filter: the Moving Average Filter, A simple high pass filter: the Moving Difference Filter, Design of echo filters, Audio experiments.
3. Frequency Resolution, Rectangular and Hamming Windows, Leakage, Bias, DTMF tones.White Noise. Peak Filters. Detection of Sinusoidal Signals Buried in Noise. Filter Design by Pole-Zero Placement.
4. FIR and IIR Filter Design using MATLAB.
5. Familiarization with DSP starter kits: Implementation of an IIR/FIR filter (LPF/BPF/HPF/ BSF) using a DSK/EVM (C50/C54/C62X).

IEBT/S/313 ELECTRONIC DESIGN LABORATORY

Design of complex digital circuits (eg. ALU, multiplier, etc.) using VHDL for design description. Designs to be verified by logic simulation and timing simulation. Real-time testing of the designs to be performed using FPGA/CPLD.

IEBT/S/314 PROJECT

Design, implementation and testing of an Electronic / Instrumentation / Control or Software system. The evaluation will be based on demonstration of the product, and oral as well as written presentation of the project report.

Third Year Second Semester

IEBT/Prod/T/321 INDUSTRIAL MANAGEMENT

Introduction to industrial management, Types of manufacturing Systems, Forecasting, Allocation of resources, Operations economy, Resource Scheduling, Work environment, Maintenance Management, Inventory Management, MRP, quality Control, Theory of Motivation, Management Information system (MIS), Organization and methods, Work Study, Operational research, Productivity, Case Studies.

IEBT/T/322 ANALYTICAL INSTRUMENTATION

Gas Analysis: Thermal Conductivity Type, Heat of Reaction Method, for oxygen analyzers – Paramagnetic, Dumbell, Servomax, Thermomagnetic, Zirconia Cell type. Spectroscopic Techniques, IR

Radiation Absorption Type, Dual-Channel IR Spectrometry, Single-Channel IR Spectrometry, IR Sources, Comparison of their performances, IR Detectors, Dispersive Spectrometry using Grating/Prism monochromator, FT-IR Spectrometer based on Michelson Interferometer.

Liquid Analysis: Different Electrodes: Ion-selective and Molecular- selective types, their variations and application prospects, Dissolved Oxygen Analysis Cells, pH electrodes, circuits and applicatons, Conductivity Cells, Standards, Effect of frequency variation, circuits, Cells for different applications, Polarography: Determination of concentrations of constituents. Apparatus, Circuits; Pulse polarography, Spectroscopic Techniques: Absorption in Visible and UV-range, monochromators and detectors, Sources and their λ - ranges, Colorimetry, Atomic Spetral Methods: Emission and Absorption: Visible, UV and X-rays; sources, principles, detectors, sample preparation etc.

Special Topics: Chromatography, GC, GLC, LC, HPLC, Columns, Detectors; X-ray methods of analysis; Humidity and Moisture; Turbidity meter and Nephelometer; Viscosity and Consistency; Density and Specific Gravity; Introduction to NMR and ESR.

IEBT/T/323 TELEMETRY AND REMOTE CONTROL

Basic Concept: Telemetry- its purpose and application potential, basic schemes- pneumatic, current, voltage, frequency over short distances. Line length limitations; Wired and wireless types.

Signals and Transforms: Signals and their representation and transformation; Frequency spectra of pulses and pulse waveforms; continuous and discrete transforms; Noise- its distribution; Probability function.

Codes and Coding: Concepts of information transfer, bits and symbols; coding source, line and channel; biasing. BCD, ASCII, EBCDIC, BAUDOT; AMI, CMI, Manchester (phase), HDBn, Block; Differential, LRC, Hamming, Convolution, M-ary; modulation Codes: PAM, PFM, PTM (PPM,PWM), PCM. Bit error rate, Parity checking, Effect of time delays and noise in bit information; Raised Cosine Spectrum and response; Noise induced bit errors etc.

Review of Modulation and Multiplexing: FM, PM, FM-FM, FM-AM, PAM-AM, PAM-FM, PCM-AM, PCM Sample and hold circuits, Quantization and Conversion methods, Errors in quantization; Bandwidth consideration.

FDM and TDM Systems: Frequency division multiplexing and demultiplexing Systems, IRIG Standards in FDM telemetry; SCO's and their circuits- Multiplexing and Demultiplexing circuits; Detectors and Demodulators, Pulse Averaging, Quadrature FM and PLL; Mixers. TDM Systems- their circuits, scanning techniques; TDM-PAM, PAM-PM Systems, Synchronization, TDM-PCM System; PCM Generation, Differential PCM Systems, PCM reception and demodulation

Modems: Digital modulation and shift keying techniques, ASK, OOK, FSK, PSK, DPSK, QPSK, etc, QAM; Modem Protocols, Synchronous protocols.
Wave Propagation: Aspects of wave propagation; Space and Surface waves, Propagation in ionosphere, other related topics.
Satellite Telemetry: Basics, TT&C Services and subsystems, the Subsystems, The earth station.

Fiber Optic Telemetry: Optic fiber as a transmission medium; Interconnections; Repeaters; Source and Detectors; Receivers, wavelength division multiplexing.

Remote Control: Concept, Examples from practical industrial situations.

IEBT/T/324 ELECTIVE-II

1. BIOMEDICAL INSTRUMENTATION
2. SOFTWARE ENGINEERING
3. NEURAL NETWORKS: THEORY AND APPLICATIONS
4. QUALITY CONTROL & RELIABILITY
5. ENVIRONMENTAL INSTRUMENTATION
6. INSTRUMENTATION FOR OIL AND GAS INDUSTRIES

IEBT/T/324A BIOMEDICAL INSTRUMENTATION

General introduction including problems in measurement of physiological parameters.

Sources of bioelectric potential, introduction of biopotential electrodes, its necessity and also its problems, transducers for biomedical applications.

Blood pressure measuring instruments: invasive and noninvasive type, manual, semiautomatic and

automatic type, details of sphygmomanometer.

Safety - range of electrical power considered as safe, precaution to be taken for safety.

Heart: engineering analog of heart, model of heart, electrocardiograph - principle of the instrument, detail instrumentation, noises and interference in the measurement, its solutions, other systems of diagnosing the heart.

Pacemaker: introduction, types, its detail instrumentation.

Instrumentation for clinical lab: blood count, flame photometry.

X-ray imaging: range for medical use, principle of x-ray generation, instrumentation of x-ray image.

Computer aided tomography (CAT): basic principle, image acquisition, mathematical modeling for reconstruction of image, block representation of the instrument and detailing of some parts.

Biotelemetry - an introduction.

IEBT/T/324B SOFTWARE ENGINEERING

Software development life cycle, Process models, Requirements, Specifications.
Software design, Structured programming and implementation.
Testing, verification and validation.
Software Metrics, Software project management.

IEBT/T/324C NEURAL NETWORKS: THEORY AND APPLICATIONS

Introduction to Neural Networks and their history, Biological Neurons and Neural Networks, Artificial Neurons, Networks of Artificial Neurons, Single Layer Perceptrons, Learning and Generalization in Single Layer Perceptrons, Hebbian Learning. Gradient Descent Learning, the Generalized Delta Rule. Practical Considerations, Learning in Multi-Layer Perceptrons. Back-Propagation, Learning with Momentum. Conjugate Gradient Learning, Bias and Variance. Under-Fitting and Over-Fitting, Applications of Multi-Layer Perceptrons, Radial Basis Function Networks: Introduction, Algorithms, Applications. Support Vector Machines: Binary Classification. Multiclass Classification. Committee Machines. Self Organizing Maps: Fundamentals. Self Organizing Maps: Algorithms and Applications. Learning Vector Quantisation (LVQ). Stochastic Machines: Markov Chains. Simulated Annealing. Boltzmann Machine.Dynamical Systems: Hopfield Networks.

IEBT/T/324D QUALITY CONTROL & RELIABILITY

Basic Concepts in Assurance Technology, Terminilogies, Definitions, Approaches and Important issues. Product Quality Control : Acceptance Sampling Methods-Single Multiple and Sequential Sampling Plans; Recent developments in inspection methods. Process Evaluation and Control by Control Charts: Various control charts including CUSUM charts and Multivariate charts. Process Evaluation and Control by Designs of Experiment: Various basic designs; Special Methods like EVOP, RSM and ROBUST Designs Process Capability Studies : Use of control charts, Various indices, SPAN PLAN METHOD and use of Nomographs Total Quality Management perspective, methodologies and procedures Road map to TQM: Quality Function Deployment, ISO 9000, Quality Cost System, KAIZEN, Quality Circles, Quality Policy Deployment and Models for organisational excellence. Reliability Engineering ; Statistical analysis of life time data and determination of Reliability, Availability and Maintainability ; Development and Applications of Fault Tree Diagrams, Cause and Effect Diagrams, FMECA and FRACAS. JIT,Total Productivity Maintenance and Quality perspectives .

IEBT/T/324E ENVIRONMENTAL INSTRUMENTATION

General introduction to pollution, its classification.

Air pollution: its effect to environment, its classification, scale of measurement, meteorological factors responsible for pollution, method of sampling - manual and automatic.

Different methods of collecting aerosol: basics of fluid properties, settling chamber- the simplest method, electrostatic precipitator - its principle, building blocks, efficiency.

Gas analysis: determination of contents of air, sulphur compounds, nitrogen compounds, oxygen etc., color dosimeter tubes and its limitations.

Sound pollution: basics of sound and sound pollution, its effect to environment.

Acoustic noise measurement: microphone, sound level meter, integrating type, intensity measuring instrument.
Acoustic noise control.

Water pollution: its effect on the environment, its classification.

IEBT/T/324G INSTRUMENTATION FOR OIL AND GAS INDUSTRIES

Brief description of Upstream & Downstream Petroleum Industry. Brief Description of reservoir characteristics, Fundamentals of Offshore Structures.
Introduction with API 6A - Brief description of Wellhead and X-mass tree equipment. Definition of SSSV, SSV (Master valve) and Wing Valve. Introduction with high pressure API 5000 ,10000 and 15,000 flanges and comparison between API 6A & ASME B16.5 flanges.
Introduction of API 14C - Introduction to Safety Analysis and safety design, Process component analysis, Safety analysis check list, Emergency Shutdown System (ESD) and Emergency Support System (ESS). Installation of Fusible Plug and ESD stations, Introduction SAFE chart (Safety Analysis and Functional Evaluation chart)
Oil & Gas Processing, Instrumentation and Control for Offshore Processing. Introduction with choke valve. Introduction of Sand Probe and monitoring system.
Instrument Gas system and criticality of sizing of PCVs for the wellhead platform, Brief description of Pneumatic Switch and High Low Pilot, Pigging process and Pig Detector, Introduction of Well head control panel (WHCP).
Necessity of Flow metering, Gas Flow Metering - AGA 3 guidelines, Liquid Metering, Crude Oil Sampling, Meter Proving System, Flow computer, Multiphase Flowmeter (MPFM).
Safety Instrumented System (SIS), High Integrity Pressure Protection System (HIPPS), Nomenclature of different types of On-Off valves - Shutdown Valve (SDV), Blow down Valve (BDV) and Motor Operated Valve (MOV), Manifold Valves. Different Types of Actuator (Scotch Yoke and Rack and Pinion type).
F&G system for Oil and Gas Industry, Brief introduction of HAZOP study
Oil and Gas Supply Chain Management.

IEBT/T/325 GENERAL VIVA VOCE

Oral examination on all the theory and sessional subjects in the curriculum.

IEBT/S/321 POWER ELECTRONICS LABORATORY

1. Evaluation of Parameters of Piecewise Linear Model of Rectifier Diodes
2. Study of Reverse Recovery in Rectifier Diodes
3. Study of Switching Performance of a Darlington Transistor
4. Study of a Single-Phase, Half-controlled Rectifier Circuit
5. Study of An SCR Forced Commutation Circuit
6. Study of A High-frequency Power MOSFET Inverter
7. Study of A Sinusoidal Pulse-Width Modulated Inverter
8. Study of an IGBT based Step-up DC-to-DC Converter
9. Study of A Step-down Converter based Battery Charger .

IEBT/S/322 TELEMETRY AND REMOTE CONTROL LABORATORY

1. Study of the characteristics of AM& FM modulator/demodulator.
2. Study of (1) pulse amplitude (2) pulse width & (3) pulse position modulation/demodulation Systems.
3. Study of pulse code modulation/demodulation systems.
4. Study of the characteristics of (1) ASK, (2) FSK&(3) PSK (BPSK and QPSK) Systems.
5. Study of a time division multiplexing system.
6. Study of the performance of a phaselocked loop as a detector.
7. Study of a superheterodyne radio receiver.
8. Study of the characteristic feature of a simple remote control system.

IEBT/S/323 OPTICAL AND ANALYTICAL INSTRUMENTATION LABORATORY

1. Measurement of temperature of a radiating body using optical pyrometer.

2. Design of a simple projection system and study of small manufactured product(s) - screw, bulb filaments etc.- using a profile projector.
3. Study of characteristics of photosensors
4. Identification of liquids and solids using Abbé refractometer
5. Design a simple scheme for the measurement of concentration of a liquid and study the effect of different incident light wavelengths on the measurement.
6. Study of an optical fibre microbend sensor.
7. Design of a simple microscope and telescope using optical lenses.
8. Measurement of small displacement using a Michelson interferometer
9. Determination of the conductivity of different liquids
10. Measurement of the moisture content of a wet solid
11. Study of a PC integrated IR temperature sensor.

IEBT/S/324 PROJECT

Design, implementation and testing of an Electronic / Instrumentation / Control or Software system. The evaluation will be based on demonstration of the product, and oral as well as written presentation of the project report.