SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY,

(PROPOSED STRUCTURE)

The following shall be the scheme of instruction and examination for the Final Year.

B.Tech. (Instrumentation) i.e. Final Year B. E. (Instrumentation).

FIRST SEMESTER, PART-I

Sr. No	Subject Code	Subject	Lecture	Pract	Total	Credit
01.	BIN 401	Instrumentation Component Design	04	02	06	05
02.	BIN 402	Process Control	04	02	06	05
03	BIN 403	Distributed Control Systems	04	02	06	05
04.	BIN 404	Digital Signal Processing	04	02	06	05
05.	BIN 405	Elective-I	04	02	06	05
06.	BIN 406	Seminar on Industrial Training	--	02	02	01
06.	BIN 407	Project Work-I	--	02	02	01
		TOTAL	20	14	34	27

SECOND SEMESTER, PART-II

Sr. No	Subject Code	Subject	Lecture	Pract	Total	Credit
01.	BIN 421	PC based Instrumentation	04	02	06	05
02.	BIN 422	Project Engineering and Management	04	02	06	05
03.	BIN 423	Control System Design	04	02	06	05
04.	BIN 424	Elective-II	04	02	06	05
05.	BIN 425	Project Work-II	--	06	06	05
		TOTAL	16	14	30	25

Elective-I

1. Opto-Electronics Instrumentation
2. Instrumentation for Agriculture and Food Processing
3. Computer Networks
4. Biomedical Signals and Processing
5. Neural Network and Fuzzy Logic based Control Systems

Elective-II

1. Advanced Sensors
2. Environmental Instrumentation
3. Advanced Digital Signal Processing
4. Embedded Systems
5. Digital Control Systems

Theory Examination

Each theory examination shall be of three hours duration.

Practical Examination

Each practical examination shall be of three hours duration. It will consist of one of the experiments performed by the student during the semester as term work and the oral based on the syllabus of that subject.

Class Tests

The class tests are meant for continuous assessment of the students. The class tests should be evenly spread over the entire period of a term and should cover the entire syllabus. In a semester, three tests (each of one hour duration) should be conducted for each subject having class test and average of best two tests should be taken as class test marks in that subject.

Term Work

For a subject having practical (2 Hours/week), the term work shall consist of at least eight experiments based on the syllabus of that subject. The experiments shall be evenly spread over the entire syllabus.

1. INSTRUMENTATION COMPONENT DESIGN

Subject Code	Lecture	Practical	Total	Credit
BIN 401	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Pract. Exam: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Basic concepts of design, Design procedure, Basic concepts of instrument design, Functional requirements and specifications of instrumentation component. (2)
2. Design aspects and selection criteria for flow, temperature, pressure, and level transducers, Orientation table, General selection criteria for transducers, General transducer design considerations.(4)

3. Design of temperature instrumentation system using RTD, thermocouple, thermistor, Selection criteria, Self heating effects in resistive temperature transducers, Power-dissipation constant and it's calculations, Thermocouple with thermowell assembly, time-constant calculation, Protection-tubes, types, materials, Design considerations for thermowell, types, Manufacturing process of T/C, RTD, Thermistor, Testing of RTD as per the Standard. (6)

4. Design of Pressure Instrumentation using Diaphragm, Bourdon tubes and Bellows, Design of Diaphragm, Bourdon tubes and Bellows elements, Design criteria, fabrication methods, diaphragm seal. (6)

5. Design of flow instrumentation using orifice, rotameter, venturimeter, different flow coefficient like Cd Cc, and Cv and their calculation. Types of orifice designs, Types of pressure taps to measure Δp, Design of orifice used in tank outflow and pipe-flow measurements, Different design considerations in orifice, venturimeter and rotameter design.(6)

6. Design of LVDT, strain gauge and design of piezo-electric crystal, Analysis of piezo-electric crystal for it's use in dynamic measurement, Time-constant of crystal assembly along with cable and amplifier, calculation of crystal capacitance.(6)

7. Design considerations for an instrument, Enclosure design guidelines, Grounding and shielding techniques, Protection against electromagnetic interference and electrostatic discharge, NEMA, ANSI standards with special reference to packaging, Packaging for various operational environments, Aesthetics design consideration in Instrument design, Heat dissipation, Forced air circulation and Humidity considerations, NEMA Enclosures. (6)

8. Electronic Design Guidelines: Noise in electronic circuits, Effects of noise and interference on measurement circuits, Component limits for intrinsic safe design, Electrical safety classification as per standards NEC, NFPA, ISA. Input filters and clamping, suppressors, intrinsically safe electronic systems, The Zener Barrier, Energy Storage calculations. (4)

9. Signal Conditioning Circuit Designs e.g. amplifiers etc., Transmitter design, Installation, calibration, maintenance and troubleshooting, specifications and reference data e.g. pressure, level Transmitter, A-to-D and D-to-A converters, their use in process- computer interface design, Methods of reducing effects of noise and interference. (4)

10. Printed Circuit Board (PCB) Design: Guidelines, General component layout schemes, Grid systems, PCB size, Design Rules for digital circuit PCB's and Analog circuit PCB's, Single and multilayer Boards, Layout w.r.t. Interference, Special design techniques for small signal paths, Automation and Computers in PCB design, Artwork CAD packages and tools, Soldering technique, Component Assembly testing, Cable design guidelines.(4)

11. Design considerations for controllers, Pneumatic controllers using flapper-nozzle mechanism, Electronics controller using op-amps, considerations in design of data presentation elements, recorders, and monitors. (4)

12. Design of a control valve, Designing control valves, Inherent and Installed characteristics of control valve, Selection of characteristics to suit the process, for gas, vapor and liquid, Valve plug design, Body design, Service control valve, Control valve sizing, Cavitations, Control valve noise, Testing, control valve capacity test procedure as per standard ANSI/ISA S75.01, Valve Actuators and petitioners. (4)

13. Control Panel Design: Design considerations, Type of control panel designs, Ergonomics in design of control, control room layout, cabling, wiring details.(2)

REFERENCE BOOKS:

1. Considine D. M., "Process Instrumentation, and Control Handbook" McGraw Hill International

2. Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001
3. Johnson C. D., "Process Control Instrumentation Technology" 7th Edition, Pearson Education, New Delhi, 2003.
4. Bentley J. P., "Principles of Measurement Systems" 3rd Edition, Pearson Education, New Delhi, 2000.
5. Nakra Chowdhari, "Instrumentation", Prentice Hall of India, New Delhi
6. Doeblin E. O., "Measurement Systems" Fourth Edition, Application and Design, McGraw Hill International Edition, 1990.
7. Warren Boxleitner, IEEE press: Electrostatic Discharge and Electronic Equipment
8. Walter C Bosshart , "Printed Circuit Boards" CEDT Series, Tata McGraw Hill
9. S. Soclop, "Applications of Analog Integrated Circuit" Prentice Hall of India
10. Ott , "Noise Reduction Techniques"
11. Andrew Williams, "Applied Instrumentation in the Process Industries" Vol. I and Vol. II , GWF Publishing Company
12. Sawhney A. K. and Puneet Sawhney " A Course in Mechanical Measurements and Instrumentation" Dhanpat Rai and Co. (P) Ltd., New Delhi, 1998.

TERM WORK:

The term work shall consist of a record of at least eight experiments/designs and drawings based on the syllabus given above. Some of the experiments may be from the following list.

1. Case study: One lab instrument/field instrument and its detailed engineering drawings, circuit diagrams on a drawing sheet.
2. Design of any mini project like design of instrument/electronic device/transducer/instrumentation component/system, its procedure starting from preparation of specifications, designing, testing, and erection. [Drawings dimensional sketches, circuit diagram, details of different component on drawing sheet, testing its specifications, determining practical static and dynamic characteristics]
3. Designing and preparing a PCB layout for electronic circuit and drawing it on drawing sheet.
4. Designing of a control panel along with detailed engineering drawings.
5. Design of a filter for typical noise problem
6. Design of any electronic intrinsically safe circuit.
7. Designing a control valve for given specifications and detailing it with engineering drawings.
8. Designing any transmitter and drawing its details.
9. Design of any sensor/transducer for particular process variables like flow/temp/Pressure and drawing its dimensional details on a sheet.

PRACTICAL EXAMINATION:

It shall consist of an oral based upon the above term-work and syllabus.

1. PROCESS CONTROL

Subject Code	Lecture	Practical	Total	Credit
BIN 402	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Pract. Exam: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Introduction to Chemical Process Control: Incentives for Chemical Process Control, Design aspects and Hardware for a Process Control System. (2)
2. Modeling of Chemical Processes: Development of a mathematical model, necessity, State Variables and State Equations, Additional Equations, Additional Elements of the Mathematical Models; Dead Time; Modeling Difficulties; The input-output Model; Degrees of freedom and process controllers; Transfer function of a process with single/multiple outputs. (5)
3. Dynamic Behavior of systems: Dynamic Behavior of First Order, second order and higher order systems; Dynamic systems with Dead Time/Inverse Response, Computer simulation of process dynamics, linearization of Non linear systems(6)
4. Controller Principles, Process characteristics, Control System Parameters, Discontinues controller Modes, Two-Position, Multipostion, Floating Control Mode, Continues controller Mode, P, I and D, Composite control Mode, P+I, P+D, P+I+D Controller modes. (6)
5. Dynamic behavior of Feed Back Controlled Processes: Input output models of feedback controllers, common measuring devices, Transmission lines, final control element Effect of on-off, Proportional, Integral, Derivative and composite control actions on the Response of a controlled Process. (6)
6. Stability Analysis of Feedback Systems: Notion of stability: The characteristic equation, stability analysis with Routh-Hurwitz criterion, Root Locus analysis. (2)
7. Design of Feed Back controllers: Outline of Design problems; simple performance criteria, time integral performance content; selection of a feed back controller; controller tuning using Cohen-Coon method; Bode Stability criterion, gain and phase margins, Ziegler-Nichols Turning Technique. (6)
8. Generation of control action: Control action generation in electronic and pneumatic controllers; control valves, valve positions, element and safety valves, relays, volume boosters, pneumatic transmitters for process variables. (4)
9. Analysis and Design of Advanced Control systems: Feedback control systems with large dead time or inverse response; cascade, selective and split range control; feed forward and ratio control; adaptive and inferential control

systems.
(8)

10. Design of Control Systems for Multi variable processes: Synthesis of alternative control, configurations for multiple input-multiple output processes, Interaction and decoupling of control loops; Design of control systems for complete plants, some case studies.
(8)

REFERENCE BOOKS:

1. T. E. Marlin, "Process Control: Designing Processes and Control Systems for Dynamic Performance", McGraw Hill International Edtion, 2000.
2. G. Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", Prentice Hall of India, New Delhi, 2001.
3. Simulation and Control for Chemical Engineering- Luyben W.L. 2nd Edition Mc Graw Hill 1989.
4. P. Harriot, "Process control" McGraw Hill International.
5. E. Umez- Eronini, "System Dynamics and Control", Thomason Learning, 2002.

TERM WORK: The term work shall consist of a record of at least eight experiments based on the syllabus given above. Some of the experiments may be from the following list.

1. Design of an electronic ON-OFF controller and plot the characteristics of natural zone of controller
2. Design an electronic PID controller and study its response for step input.
3. Design electronic temperature transmitter for transmitting temperature from 50^{O}C to 90^{O}C to 4 to 20mA
4. Study stepper motor control using stepping motor control kit.
5. Plot the control valve characteristics.
6. Study the close loop flow control system
7. Determine the time-constant of RTD for given step-input.
8. To determine the mathematical model of the given process
9. To determine the constants of PID controllers by given method.
10. Use of dead beat algorithm and other algorithms in the controller design
11. Use of optimum controller methods for tuning of PID controller.

PRACTICAL EXAMINATION: It shall consist of any one experiment based upon the termwork and syllabus. The examination shall not be less than three hours duration.

3. DISTRUBUTED CONTROL SYSTEMS

Subject Code	Lecture	Practical	Total	Credit
BIN 303	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Programmable logic controllers (PLC): Introduction, architecture, definition of discrete-state process control, discrete – state variables, process specifications, Event sequence description, ladder diagram: Background, ladder diagram elements ladder diagram examples, programmable controllers: Relay sequencer, programmable controllers, programmable controller operation, programming, advanced features, ladder diagrams and programming for some typical examples of process control study of at least one industrial PLC make. (8)
2. Introduction to supervisory control and data acquisition (SCADA) as applied to process control systems. (6)
3. Introduction to Hierarchical control memory optimization of empirical process. (4)
4. Personal computers (PC) in process control direct digital control distributed process control, advanced process control (APC) (4)
5. DCS configuration: Supervisory computer functions, control techniques, supervisory control, algorithm DCS and supervisory computer displays, advanced control strategies computer interface with DCS. (6)
6. Data highways, field buses, multiplexers and remote sensing terminal units. (3)
7. I/O hardware, set point stations, CRT displays printers and operators interface. (3)
8. Supervisor computer tasks and configuration. (2)
9. Systems integration with PLC's and computer (Hybrid Control System). (4)
10. Network protocols, MAP/TOP (2)
11. Study of TDC-3000, Rs-3, ABB MOD 300: Yokogawa centum –CS (at least two) (4)

TERM WORK: Termwork shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list.

1. Study of Anshuman PLC
2. Developments of Ladder diagram for the controlling motor operation
3. Development of ladder diagram and Simulation for the level control system.
4. Development of Ladder diagram for bottling plant.
5. Study of Software package for SCADA

6. Development of mimic diagram for a particular process using SCADA software
7. Study of Logo PLC
8. Development of Ladder diagram using logo software for different processes.

REFERENCE BOOKS:

1. Gary Dunning, "Introduction to Programmable Logic Controllers" Second Edition, Thomson Delmar learning, 2002.
2. C. D. Johnson, "Process Control Instrumentation Technology" Seventh Edition, Pearson Education, New Delhi 2003.
3. Instrument Engineers handbook –B. G. Liptak (Ed) Vol-II and III, Chilton book Company.
4. Technical Manual – Manuals of TDC – 3000 Rs-3, ABB MPD 300 Yokogawa centum-CS
5. Distributed control system – M. Lucas
6. Distributed control system – Peter and Bhatkar
7. Webb J. W., "Programmable Controllers: Principles and Applications", Mergy/publishing co. 1988
8. Parr A. "Programmable Controllers: An Engineer's Guide", Newnes, Butterwoth-Heinmen Ltd. 1993.
9. C. D. Johnson, "Microprocessor based Process Control", Prentice Hall International Edition.

4. Digital Signal Processing

Subject Code	Lecture	Practical	Total	Credit
BIN 404	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

Signals and Signal Processing (4 Hours)

Motivation, Characterisation and classification of signals, signal processing operations, examples of signals, signal-processing applications.

Discrete time signals and systems in the time domain (4 Hours)

Discrete time signals, typical sequences and sequence representation, the sampling process, Discrete time systems, Time domain characterization of LTI discrete time systems, Finite dimensional LTI Discrete time systems, correlation of signals, Random signals.

Discrete Time signals in Transform domain (10 Hours)

Discrete time Fourier transform, Discrete Fourier Transform, Relationship between the DTFT and the DFT and their inverses, Discrete Fourier Transform properties, Computation of the DFT of real sequences, Linear convolution using the DFT, The Z-transform, ROC of the rational Z-transform, Inverse Z-transform, Z-transform properties, Transform domain representation of random signals.

LTI Discrete time systems in Transform Domain (6 Hours)

Finite dimensional Discrete time systems, the frequency response, the transfer function, types of transfer functions, Simple digital filters, All pass Transfer function, Minimum phase and maximum phase transfer functions, Complementary transfer functions, Inverse systems, Systems identification, Digital two pairs.

Digital filter structures (6 Hours)

Block diagram representation, equivalent structures, Basic FIR structures, Basic IIR structures, All pass filters, IIR tapped cascaded lattice structures, FIR cascaded lattice structures.

Digital Filter design (6 Hours)

IIR filter design – Bilinear transformation, Impulse invariant transformation, Lowpass IIR digital filters, Spectral transformations, FIR filter design using windowing techniques, Frequency sampling technique, and Computer aided design.

DSP algorithm implementation (6 Hours)

Computation of DFT, FFT algorithms, Decimation in time, Decimation in Frequency, Different algorithms of FFT such as DIT and DIF where input and output is in order, radix-n algorithms.

Hilbert transforms, homomorphic systems and their use for deconvolution, cepstrum Analysis (6 Hours)

DSP processors (6 Hours)

Embodiments and different alternatives, Data paths-Fixed point, floating point, Special function units, Different addressing modes, Instruction set, Choosing a processor architecture and DSP processor trends.

Applications of DSP (4 Hours)

Speech, images, control systems, sampling rate alterations, introduction to sub-band coding.

TERM WORK: Termwork shall consist of at least six to eight assignment/tutorials/practical based on above syllabus. Some of the experiments may be from the following list.

Students are supposed to write the programs (at least Eight) on general-purpose computer using any development environment (C/C++/Matlab) or on any DSP processor and development environment

1. Digital signal generation
2. Simple operations on signals
3. Linear Convolution
4. Discrete time Fourier transform
5. Discrete Fourier Transform - Direct computation, DIT algorithm, DIF algorithm
6. FIR filter design and software realization by windowing and Frequency sampling
7. IIR Filter Design and software realization of Butterworth and Chebyshev approx.
8. Any other experiment decided by the teacher

REFERENCE BOOKS:

1. E. C. Ifeachor, B. W. Jarvis, Digital Signal Processing- A Practical Approach, Second Edition, Pearson Education, New Delhi, 2002.
2. S. K. Mitra, Digital signal processing- A computer based approach, Tata McGraw Hill, 2002
3. A. V. Oppenheim, R, W, Schafer, Discrete time signal processing, Prentice-Hall of India, 2001.
4. J. G. Proakis, D. G. Manolakis, Digital signal processing –Principles, algorithms and applications, Prentice Hall of India, 2002.
5. R. G. Lyons, "Understanding Digital Signal Processing", Pearson Education New Delhi, 1999.

5. ELECTIVE –I

5(i) Opto-ELECTRONICS INSTRUMENTATION

Subject Code	Lecture	Practical	Total	Credit
BIN 405	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Light and Elements of solid state physics nature of light, wave nature of light, light sources black body radiation, units of light Energy bands in solids, semiconductor types, works function, functions. (4)
2. DISPLAY DEVICES: Luminescence, Insertion Luminescence and the light emitting diode, Radiative recombination processes LED materials, commercial LED materials LED construction, response time of LEDs, LED drive circuitry plasma display liquid crystal displays. (5)
3. LASERS: Emission population inversion, optical feedback classes of laser, doped insulator lasers semiconductor lasers, gas lasers, liquid dye lasers, laser applications, measurement of distance holography. (9)
4. PHOTODETECTOR: Thermal detectors: thermoelectric detectors, the bolometer, pneumatic detector, pyroelectric detector photo devices photoemissive devices vacuum photo diodes photo multipliers, noise in photo multipliers, image intensifier photo conductive detection photo transistor etc. (8)
5. OPTICAL FIBERS: Classification of optical fiber, principle of light transmission through a fiber, fabrication of optical fibers, material consideration loss and band width limiting mechanism, preform fabrication technique, fiber drawing, fiber optic communication system introduction to fiber optic sensors: Temperature pressure, level etc. (9)
6. OPTO ELECTRONIC POWER DEVICES: Solar cells and their application (3)

7. OPTO ISOLATORS: Different types and their configuration applications.
   (3)
8. OPTICAL INSTRUMENTS: Calorimeter, spectrophotometer, flame photometer fluorimeter and turbidity meter.
   (5)

REFERENCE BOOKS:

1. Semiconductor Optoelctronic Devices, Second Edtion, Pallab Bhattacharya, Pearson Education, New Delhi, 2002.
2. Opto Electronics – An Introduction J. Wilson J.F.B.Hawkes, Prentice Hall of India New Delhi 1996.
3. Integrated circuits and semiconductor devices: theory and application – Deboo Burrous McGraw Hill second edition.
4. Optical fiber communications Principals and Practice J. M. Senior Prentice Hall of India, second Edition, 1996.
5. Fiber optics – communication and other application H. Zanger and C. Zanger McGraw Publication
6. Optical Fiber Communication, Gerd Keiser

TERM WORK: The termwork shall consist of record of conduct of minimum six experiments from the following list.

1. To plot spectral response characteristics of photo diode.
2. To plot spectral response characteristics of phototransistor.
3. To plot intensity response of photo diode
4. To plot intensity response of phototransistor.
5. Study of fiber optic communication trainer kit.
6. Study of turbidity meter.
7. Study of spectrophotometer.
8. Study of flame photometer.

5(ii) INSTRUMENTATION for agriculture and food processing

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Introduction, necessity of instrumentation and control for food processing and agriculture sensor requirement, remote sensing, biosensors in Agriculture, standards for food quality.
   (4)
2. (a). Soil science and sensors: P^H, conductivity, resistivity, temperature, soil moisture and salinity, ion concentration, measurements, methods of soil analysis.
   a. Instrumentation for environmental conditioning of seed germination and growth.
   (6)

3. (a). Flow diagram of sugar plant, sensors and instrumentation set-up for it.
(b) Flow diagram of fermenter and control (Batch process)
(b) Oil extraction plant and instrumentation set-up
(c) Pesticides manufacturing process and control
(6)

4. (a) Flow diagram of Diary and confectionary industry and instrumentation set-up.

(b) Juice extraction control set-up
(4)

5. (a) Application of SCADA for DAM parameters and control
(b) Water distribution and management control, Auto-Drip irrigation systems
(c) Irrigation Canal management, upstream and downstream control concepts, supervisory control.
(6)

6. Green houses and Instrumentation; ventilation, cooling and heating wind speed, temperature and humidity, rain gauge, carbon dioxide enrichment measurement and control.
(6)

7. (a) Automation in Earth Moving Equipment and farm implements, pneumatic, hydraulic and electronic control circuits in harvesters, cotton pickers, tractors etc.
(b) Application of SCADA and PLC in packaging industry.
(6)

8. (a) Leaf area, length, evapotranspiration, temperature, wetness and respiration measurement and data logging. Electromagnetic, radiation, photosynthesis, infrared and CV, bio sensor methods in agriculture.

(b) Agro meteorological instrumentation weather stations.
(6)

REFERENCE BOOKS:

1. Considine D. M., "Process Instrumentation, and Control Handbook" McGraw Hill International
2. Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001
3. Johnson C. D., "Process Control Instrumentation Technology" 7th Edition, Pearson Education, New Delhi, 2003.
4. D. Patranabis, "Industrial Instrumentation" TaTa McGraw Hill publications, New Delhi.

TERM WORK: The termwork shall consist of record of conduct of minimum eight experiments/assignment/tutorials based on the above syllabus.

5(III) COMPUTER NETWORKS

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical**: 2 Hrs./Week

1. Introduction to computer networks uses of computer network, networking concepts, concepts of protocol, some simple examples. Layering concept in computer networks, need for standardization, OSI and TCP/IP reference models, terminologies and definitions, services and primitives.
   (6)
2. The physical layer: Theoretical basis for data communication, Guided Transmission media, Wireless transmission, Communication satellites, The public switched telephone networks, Mobile Telephone system.
   (4)
3. Data link layer, definition and scope, Design issues; services provided, framing techniques. Error control, flow control, link management examples of data link protocols, sliding window protocols, one bit sliding window protocol, A protocol using Go back selective repeat, protocol performance impact of sliding window, examples of data link layer.
   (6)
4. Medium access control sublayer: The channel allocation problem, multiple access protocols, Ethernet, Wireless LANS, Broadband Wireless.
   (4)
5. Network layer concepts, networks layer design issues- LAN and WAN services, frame formats and options, network design issues, routing algorithms, flow control, congestion control algorithms
   (6)
6. Transport layer concepts: The transport service, Elements of transport protocols, A simple Transport protocol, the Internet transport protocol: UDP and TCP, Performance issues.
   (6)
7. Application layer concepts: DNS- the domain name system, electronic mail, the World Wide Web, multimedia.
   (4)
8. Network security: Cryptography, Symmetric key algorithms, public key algorithms, digital signature, management of public keys, communication security, E-mail security, web security, social issues.
   (6)

REFERENCE BOOKS:

1. A. S. Tenenbaum, “Computer Networks”, Fourth Edition, Prentice Hall of India, New Delhi, 2002.

2. W. Stallings, "Data and Computer communication, 6th Edition, Pearson Education, New Delhi, 2001.
3. Comer, "Computer Networks and Internets", Second Edition, Pearson Education, 2001.

TERM WORK: The termwork shall consist of record of conduct of minimum eight experiments/assignment/tutorials based on the above syllabus. Some of the experiments/assignments may be from the following list.

1. Study of Institute wide computer networking: A case study
2. To connect a printer in a network
3. Study of hardware components used in computer networking.
4. Study of OSI and TCP/IP protocols.
5. Study of simulator for experimentation with data link layer.
6. Design and development of a web page.
7. Study of Internet control protocols.
8. Write a program to implement bit-stuffing algorithm
9. Write a program to implement Bellman Ford algorithm
10. Write a program to implement character-stuffing algorithm
11. Write a program for encryption and decryption
12. Write a program for implementing Hamming code
13. Study of file transfer protocol and sliding window protocol.
14. Study and comparison of different routing algorithms.

5(iV) BIOMEDICAL SIGNALS AND PROCESSING

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Basic Neurology: Nervous system, neuron, resting potential, biopotential, Nernst equation, electrical equivalents.
   (2)
2. Electrical activity of the heart: Cardiac system, bipolar and unipolar lead system, Einthoven triangle, electrodes, electrocardiogram-normal and abnormal, exercise ECG, lead positioning, electrode positioning for Holter ECG recording, vector cardiography, signal conditioning and processing.
   (4)
3. Electrical activity of neuromuscular system: muscular system, electrical signals of motor unit and gross muscle, human motor coordination system, electrodes, correlation of force and work, EMG integrators, signal conditioning and processing.
   (6)
4. Electrical activity of the brain: Sources of brain potential, generation of signals, component waves, EEG recording electrodes, 10-20 electrode system, EEG under Grand mal and petit mal seizures, signal conditioning and processing.
   (6)

5. Electrical signals from visual system: Sources of electrical signals in eye, generation of signals, electro-retinogram, elctro-occulogram. (4)
6. Electrical signals from auditory system: Generation of cochlear potential and nature, evoked responses, auditory nerves, signal conditioning and processing. (4)
7. Noise and interference in biomedical signals: Sources of noise in biomedical signal recordings, filtering techniques-active and passive filters, digital filtering, grounding and shielding. (4)
8. Computer applications and Bio-telemetry: Real time computer applications, data acquisition, compression and processing, remote data recording and management. (4)
9. Digital signal processing and data compression: Typical signal processing operations, time-domain operations, correlation and covariance, convolution, Digital filters: Smoothing filters, least square polynomial smoothing, windowing, FFT, DFT, Decimation in time and decimation in frequency FFT program. Data compression techniques: Direct data compression methods, Tolerance-comparison data compression techniques, polynomial predictors: Zero order predictor (ZOP), First order predictor (FOP), Polynomial interpolation: Zero order interpolator ZOI and FOI. AZTEC, MAZTEC, TP, CORTES, FAN, SAPA, DPCM, Entropy coding method, Peak picking method, cycle-to-cycle compression technique, Huffman coding, EBP-ANN based technique: Data compression-retrieval performance indices. (10)
10. Medical imaging: Diagnostic X-rays, CAT, MRI, thermography, ultrasonography, medical uses of isotopes, endoscopy. (4)

REFERENCE BOOKS:

1. W. J. Jonkins, "Biomedical Digital Signal Processing", Prentice Hall of India, New Delhi.
2. G. F. Ihbar, "Signal Analysis and Pattern Recognition in Biomedical Engineerin", John Wiley and Sons.
3. R.S. Khandpur , "Hand Book of Biomedical Instrumentation.", Tata McgraHill Publ.
4. H.K. Wolf and P.W. Macfarlane (Editors) , "Optimization of Computer ECG Processing." ,North Holland Publishing Co., Austerdun
5. Carr and Brown, " Biomedical Instrumentation."
6. M.J. Goldman, " Principles of Clinical Electrocardiogrphy."

TERM WORK

Term work shall consist of at least eight-assignment/ programs/ tutorials based on above syllabus.

5(V) NEURAL AND FUZZY BASED CONTROL SYSTEMS

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks
Teaching Scheme: Lecture: 4 Hrs./Week **Practical**: 2 Hrs./Week

1. **Artificial Neural Systems:** Preliminaries, fundamentals concepts and models of artificial neural system, neural network learning rules, Hebbian, Perceptron, delta Windrow-Hoff learning rules.
   (5)
2. **Single layer Perceptron Classification:** Classification model, features and decision regions, training and classification using discrete perception, algorithm and example, single layer continuous Perceptron networks for linear separable classification (5)
3. **Multilayer Feed forward Networks:** Generalized delta learning rule, feed forward recall and error back propagation training, learning factors
   (3)
4. **Single layer feedback networks:** Basic concepts of dynamical systems mathematical foundation of discrete time and gradient type Hopfield networks, transient response of continuous time networks solution optimization problems
   (4)
5. **Neural network in control system:** Neuro control approaches, training algorithms, evaluation of training algorithms, through simulation, self running neuro-control scheme, self tuning PID neuro controller, neuro control scheme feed water bath temperature control system
   (7)
6. **Introduction of fuzzy control:** Introduction fuzzy control from an industrial perspective, mathematical of fuzzy control fuzzy sets, fuzzy relation, approximate reasoning representing a set of rules
   (5)
7. **Fuzzy knowledge based controllers FKBS design parameters:** Structure of FKBC fuzzification and defuzzification module, rule base choice of variable and contents of rules, derivation of rules, data base choice of membership function and scaling factors, choice of fuzzification, defuzzification procedure
   (7)
8. **Introduction to Genetic Algorithms:** Fundamentals, History, Creation of offsprings, Working Principle, Encoding, Fitness function, Reproduction, Inheritance Operators, Cross over, Inversion and Deletion, Mutation operator, Bit-wise operations, Generational cycle, Convergence of Genetic Algorithms, Applications in Control. (6)

TERM WORK:
Term work shall consist of at least eight-experiment/ programs/ assignment based on above syllabus. Some of the experiments/assignments/programs may be from the following list.

1. Write a program to test the functioning of the artificial neuron with binary and continuous actuation function.

2. Write a generalized program to process the data by using the feed-forward neural network.
3. Write a program for the learning of the feed forward neural network-using delta learning neural network.
4. Write a program to study the effect of different network parameter on the performance of the neural networks.
5. Write a program to generate the different membership functions.
6. Develop an experimental set-up of water bath and associated electronic circuitry to acquire the data from the process.
7. Develop an experimental set up to control the temperature of water bath using direct neural controller.
8. Develop an experimental set up to control the temperature of water bath fuzzy PID controller.
9. Write a program to implement Genetic Algorithm and test it on some application.

REFERENCE BOOKS:

1. M. T. Hagan, H. B. Demuth and M. Beale, "Neural Network Design" Thomson Learning, Vikas Publishing House, New Delhi, 2002.
2. J. M. Zurada, "Introduction to Artificial Neural Systems", Jaico Publication House 1997.
3. S. Haykin, "Neural Networks: A Comprehensive Foundation", Pearson Education, New Delhi, 2002.
4. John Yen and Reza Langari, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education New Delhi, 2003.
5. S. Rajsekaran, G. A. Vijayalaxmi Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms, Synthsis and Applications", Prentice Hall of India, 2003.
6. S. Omatu, M. Khalid and R Yusof, "Neuro Control and its Applications", Springer – Verlag, London Limited 1996.
7. D. Driankov H. Hellendoorn and M. Reinfrank, "An Introduction to Fuzzy Control", Narosa Publication House, Second Reprint, New Delhi, 1997.

6. SEMINAR ON INDUSTRIAL TRAINING

Subject Code	Lecture	Practical	Total	Credit
BIN 406	---	02	02	01

Term work: 25 marks
Teaching Scheme: Practical: 2 Hrs./Week

A Talk will be delivered by the student based on Industrial Training work undertaken by the student during summer vacation after 3rd year. Industrial work of each student will be evaluated by two teachers appointed by Head of the Institution for giving term work marks. In case a student fails to obtain permission for program training from any industry, the department concerned can plan an equivalent program in the different laboratories under the guidance of faculties. The organizations where practical training will be preferred are: Process Industries, Instrumentation System Design, Instrument

Manufacturing organizations, Research and Development establishments, Consultancy firms, Standards and Calibration laboratories.

7. PROJECT WORK-I

Subject Code	Lecture	Practical	Total	Credit
BIN 407	--	02	02	01

Term work: 50 marks
Teaching Scheme: Practical: 2 Hrs./Week

TERM WORK: Term work will be carried out by a batch of at the most two candidates. It shall consists of a report based on –

1. Laboratory work involving design and construction aspects for any instrumentation applications.
2. Design modification with fabrication of an existing equipment.
3. Investigation of practical problems in the manufacture and or testing of electronic or process equipment.
4. Proposing a theoretical design methodology/ or existing method for any instrumentation and control application and development of software for its simulation showing the validity of the results obtained.

The candidates will have to complete at least the design methodology and aspects of the project work.

TERM WORK ASSESSMENT: The following shall be the break up of the 50 marks allotted for term work.

A. The presentation given by the candidate will be allotted marks out of 20. The presentation will be attended and evaluated by a group of three teachers, one of whom shall be the guide and the remaining two will be appointed by Principal of the institute.
B. Out of remaining 30 marks the guide will assess and allot marks to the report based on –
    1. Quantum of work
    2. Quality of the report
    3. Regularity of the candidate in the project work and in submission and discussion with guide.

SECOND SEMESTER

1. PC BASED INSTRUMENTATION

Subject Code	Lecture	Practical	Total	Credit
BIN 421	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Pract. Exam: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. **The Processor 8086/8088**: CPU architecture, register organization, memory organization, minimum mode and maximum mode 8086 system and timings, The processor 8088, 8086/8088 instruction set and assembler directives, Assembly language programming for 8086/8088:Assembler instruction format, Data transfer instructions, arithmetic instructions, Branch instructions, loop instructions, NOP and HLT instruction, Flag manipulation instructions, logical instructions, shift and rotate instruction, study of MASM assembler, string manipulation instructions (10)
2. **Intel 80286, 80386, 80486 and Pentium (80586) microprocessors:** Introduction, architecture, salient features of instruction set, coprocessors 80387 and 80486DX, Salient features of 80586 (Pentium), enhanced instruction set of Pentium, Intel MMX architecture, MMX instruction set, Journey from Pentium-pro to Pentium-IV. (10)
3. **Basic peripherals and their interfacing with personal computer:** Semiconductor memory interfacing, Dynamic RAM interfacing, Interfacing I/O ports, Interfacing of bipolar to unipolar converters, signal conditioning circuits, Sample and hold circuit interfacing, Interfacing circuits for actuators and final control elements, Interfacing A/D and D/A converter cards, PC based hardware and software for Data Acquisition Systems (DAS). (12)

4. **PC based Control Systems:** open loop control system-stepper motor interfacing and controller, Closed loop control system-bang bang temperature control; closed loop position control system, PID controller and digital controller design and implementation for PC based control applications, PC based measurement and control of physical quantities like temperature, flow etc., Design of PC based electronic weighing bridge etc. (10)

5. Instrumentation buses like GPIB etc., Introduction to application oriented instrumentation software like LabView etc. and its use in instrumentation and control.(6)

TERM WORK:

The term shall consist of a record of minimum six experiments from the given list

1. Study of hardware details of IBM PC
2. Study of debug and execution of assembly language program (at least three)
3. Study of macro assembler and execution of three assembly language program
4. Use of PC for digital input/output
5. Design of I/O card for IBMPC
6. Study and use of data acquisition card for instrumentation application
7. Communication between a microprocessor and PC by using serial I/O.
8. Interfacing of A/D and D/A cards with PC.

9. Interfacing of stepper motor with PC.
10. Design of PC based temperature ON/OFF controller.

PRACTICAL EXAMINATION: Examination shall consist of performing one experiment based on the above list along with practical/oral. The practical examination will not be of less than 3 hours duration**.**

REFERENCE BOOKS:

1. Yu-Cheng Liu, Glenn A Gibson, "Microcomputer system: The 8086/8088 family Architecture Programming and Design", Second Edition Practice-Hall of India Pvt. Ltd New Delhi.
2. Douglas V. Hall, "Microprocessor and Interfacing Programming and Hardware", International Edition McGraw Hill Book company Singapore.
3. MASM user handbook and reference manual from Microsoft.
4. Intel Manual for microcontroller.
5. A. K. Ray and K. M. Bhurchandi, "Advanced Microprocessors and Peripherals: Architecture, Programming and Interfacing", Tata McGraw Hill publication, New Delhi, 2000.
6. B. Ram, "Advanced Microprocessors and Interfacing", Tata McGraw Hill publication, New Delhi, 2001.
7. J. L. Antonakos, "The Pentium Microprocessor", Pearson Education, New Delhi, 2003.
8. J. L. Antonakos, "An Introduction to the Intel Family of Microprocessors", Pearson Education, New Delhi, 2003.

2. PROJECT ENGINEERING AND MANAGEMENT

Subject Code	Lecture	Practical	Total	Credit
BIN 422	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Pract. Exam: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Definition of the project, Project objectives, Need, Scope, Project implementation. (2)

2. Project procedure, Project schedule, Work co-ordination, Project Manager and his functions, Project procedures, Schedules, Manpower allocations, Job progress, Cost control, Project organization chart, Functions of key persons, Accounting procedure, Approval procedures, Process engineer, Equipment engineer, Piping design supervisor, Co-ordination with other groups like Structural, Architectural and Civil, Electrical, Purchasing and Expediting, Others like owner representative, Operation and Maintenance, Vendors, Contractors , Design group , Department Supervisor. (6)
3. Project Engineering: Documentation: Document system, Process flow sheet, Mechanical flow sheets, (P & I Diagrams), Standard Symbols and Legends, Instrument index sheet, Instrument Specification Sheets, Loop wiring diagram, Panel Drawings and Specifications, Plot Plans, Hookup diagrams, Installation details, Special drawings, Purchase Requisition, Piping specifications, Electrical specifications, Bid documents.
(6)
4. Procurement Activities: Vendor documents and Vendor drawing, Purchasing and Expediting, Job execution, Planning hints, Tendering and bidding process, Bid evaluation, Purchase Orders.
(6)
5. Scheduling, Specifying instruments, Vendor selection, Shipping, Receiving and storing instruments, Installation and checkout, Project checklist, Design considerations, Equipment delivery.
(6)
6. Detailed Engineering and Documentation, Plant layout, drawing, Different wiring diagrams, Interlock diagrams, Control panel diagram, Instrument data sheet, Checklist, Tests and progress report, Control system documentation.
(4)
7. Engineering Design Criteria, Pneumatic V/s Electronic V/s Hydraulics, Cost, Dependability, Safety, Maintenance, Process control requirements, Control centers, Location, Layout, Electrical classification, Utilities, Future and spare capacity, Specifications for various measurement and control groups.
(4)
8. Transmission systems: Pneumatic, Electronic, Identification, Process connections, Location of taps, Sealing instruments from the process, Mounting instruments, Selection of units, chart, ranges, Instrument Identification, Winterizing.
(4)
9. Construction activities, Installation and commissioning activities and documents require, On site inspection and testing (SAT) installation, Bill of materials (BOM), Contracting, Cold commissioning and hot commissioning, Inspection and testing, Customer acceptance test (CAT).
(6)
10. Control console, Centers and panels, Types, Inspection and specification.
(2)
11. Field bus wiring, Networking.
(2)

12. Project Monitoring: PERT/CPM techniques, Project bar chart, Network diagram, Fixing criteria path.
(2)

TERM WORK:

It shall consist of following (Minimum 6 drawing sheets and report on them)

1. Instrument symbols
2. Equipment symbols
3. Study of typical process flow sheet
4. Study typical specification sheets of sensor, transmitters, control valves etc.
5. P & I diagram of typical process
6. Loop wiring diagram
7. Control panel and its wiring
8. Control diagram of a typical process unit
9. (e.g. Boiler, Heat exchanger, Distillation column etc.)
10. Study of typical Indian projects like Sugar, Fertilizers, Cement, Power industries etc.

PRACTICAL EXAMINATION:

It shall consist of an oral based upon the term work and syllabus.

REFERANCE BOOKS:

1. Andrew and William, "Applied Instrumentation in the Process Industries. Volume II" Gulf Publishing Company.
2. Liptak B. G., "Instrument Engineers Handbook, Process Measurement Volume I and Process Control Volume II" Chilton Book Company, 2001
3. Hiller and Lieberman, " Introduction to Operations Research", Tata McGraw Hill. 7th Edition, 2003
4. Harold Kerzner, "Project Management- A systems approach to planning, scheduling and controlling", 5th Edition.
5. John Bacon, "Management Systems", ISA Publications.
6. Fisher T. G., "Batch Control System", ISA Publications
7. Instrument Installation Project Management, ISA Publications

2. CONTROL SYSTEM DESIGN

Subject Code	Lecture	Practical	Total	Credit
BIN 423	04	02	06	05

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Frequency domain design of control systems (10)

The design problem, preliminary consideration of classical design, realization of basic compensators, cascade compensation in frequency domain, phase lead, lag, lead-lag controllers (Electrical, Electronics and Mechanical type), their transfer function Bode plots, polar plots, design procedure, effects and limitations, feedback compensation in frequency domain.

2. Time domain design of control systems (06)

Cascade compensation in time domain; lead, lag lead-lag compensation using root locus techniques, polo-zero cancellation control, Bridge-T networks and cascade compensation.

3. State variable method and design of linear systems (14)

Concept of state, state variable, and state model, state space representation using physical, phase and canonical variables and their block diagram representation, state model and transfer function, diagonalization, solution of state equation, state transition matrix its properties and computation, concept of controllability and observability and their test criterion, pole placement design using state feedback, state observer, reduced order and full-order observer design, Design of control systems with observers, Design of servo system, Introduction to Optimal Control systems, Linear Quadratic regulator (LQR): Theory and Design.

4. Non-linear system analysis: (10)

Behavior of non linear systems, common physical nonlinearities, describing function method, concept derivation of describing function method, phase plane method, singular points, stability of non linear system, construction of phase trajectories by isocline method, nonlinear system analysis by phase plane method.

TERM WORK

Term work shall consist of at least eight-assignment/ programs/ tutorials based on above syllabus. Some of the assignment/programs/tutorials may be from the following list:

1. Introduction to MATLAB's Simulink and control systems toolbox (with some examples) or any other control system related software package.
2. Design of lead, lag, and lead-lag compensation for transfer functions of representative control systems of temperature control, space craft control etc. and comparison of unit step responses of compensated and uncompensated system using MATLAB. Use design based on root locus method.
3. Design of lead, lag, and lead-lag compensation for transfer functions of representative control systems of temperature control, space craft control etc. and comparison of unit step responses of compensated and uncompensated system using MATLAB. Use design based on frequency domain approach.
4. Obtain the transfer function of the electromechanical system and hence the give space representation of the same.
5. Develop a MATLAB program for pole placement design using conventional approach and apply it for inverted pendulum.
6. Develop a MATLAB program for pole placement design using Ackermann's formula and apply it for inverted pendulum.

7. Obtain the solution of state equation using different methods.
8. Obtain the expression for the describing function for the different non-linearity.
9. Solve the problems on the methods of isocline method, nonlinear system analysis by phase plane method

REFERENCE BOOKS:

1. K. Ogata, "Modern Control Engineering", Fourth Edition, Prentice Hall of India, 2002.
2. G. Franklin, J. D. Powell and A. E. Naeini, "Feedback Control of Dynamic Systems", Fourth Edition, Pearson Education, 2002.
3. I. J. Nagrath and M. Gopal, "Control System Engineering",Second Edition, Wiley Eastern Limited, Sixteenth reprint 1990.
4. M. Gopal, "Control Systems, Principles and Design", Second Edition, TMH, New Delhi, 2002.
5. B. C. Kuo, "Automatic Control Systems", Seventh Edition, Prentice Hall of India, New Delhi, 2002.

4. ELECTIVE –II

Subject Code	Lecture	Practical	Total	Credit
BIN 424	04	02	06	05

4(I) ADVANCED SENSORS

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks
Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Introduction to advanced sensors technology: Design and Development of sensors using VLSI technology, Silicon Planar technology, Micromachining technology. MicroElectroMechanical Systems (MEMS) overview. (06 hours)
2. Design of sensors: Micro sensors for sensing radiation, mechanical, magnetic, chemical and other signals. Thick and thin film sensors, design principles. (06 hours)
3. Semiconductor sensors fabrication principles: Metal Oxide Semiconductors (MOS) structures, Process steps such as RCA cleaning, Thermal oxidation, Lithography, Etching, Metalization etc.
(08 Hours)

4. Chemical and biochemical sensors: Polymers, Chemically modified Electrodes (CME), affinity sensors, Potentiometric and Amperometric devices, catalytic sensors, Gas sensors etc.
   (08 hours)
5. Optical sensors: Lasers, Photo-detectors and optical fibre as sensors, integrated optics.
   (04 hours)
6. Interfacing and Signal processing: Intelligent and Smart sensors, Concepts of redundant and multisensory systems. (04 hours)
7. Study of sensor design software and simulation packages such as IECTCAD, Tanner tools, AutoCAD etc. Case studies.
   (04 hours)

REFERENCE BOOKS:

1. Middlehock S. and Audel S. A., "Silicon Sensors", Academic Press, London 1999.
2. Jiri Janata and Robert J. Huber, "Solid State Chemical Sensors", Academic Press, Inc. London, 1985.
3. S. M. Sze, "Semiconductor Sensors"

TERM WORK:

1. Sensor design for any parameter sensing. e.g. Piezoelectric sensor design or Gas sensor design. (Assignment)
2. Study of CAD software packages. (Lab. Work)
3. Mask layout preparation for the designed sensor using any CAD package. (Lab. Work)
4. Study of processing equipment for fabrication of the designed sensor. (Assignment)
5. Study Integrated sensing system design. (Assignment)

4(iI) ENVIRONMENTAL INSTRUMENTATION

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Environmental definition, constituents, biochemical cycle, causes of pollution, types of pollution and their measurements, effects of pollution, different sensors for measurement of pollution, difference between off-line measurement and continuous monitoring. (3)
2. Environmental toxicology and hazards, common toxic agents, their analysis and safety measures, environmental regulation and standards. (3)
3. Review of standard methods of pollution analysis, sampling operation, devices and techniques as related to environmental engineering. (3)

4. Air pollution analysis : Analysis of aerosols and monitoring of gaseous pollutants like So_2, H_2S, NO-Nox, CO-CO_2, Ozone, NH_3 and organic gases, vapour analysis, monitoring of suspended particles and trace material pollutants. (4)
5. Water Pollution analysis: Physical examination colour, conductivity, temperature, colour, turbidity, hardness, chemical characterization – Ca2+, Mg2+,Na+, Cl-, SO4+2-, HCO3-, Al3+, Ba2+Boron, F-, NO2-, PO4 3-, Fe3+, Mn2-, Sio2 2-, Biological investigation - DO, BOD, bacteriological examination, types of water quality monitoring instrumentation (p^H meters, conductivity meters etc.) (4)
6. Effluent Analysis: Physical methods of characterization: density, viscosity, temperature, turbidity, volatile and dissolved solids, oil and immiscible liquids, colour odour, radio activity, analysis of organic pollutants.

   BOD, COD, TOC specific analysis of organic pollutants, analysis of metal pollutants, analysis of anion and dissolved oxygen, p^H, dissolved chlorides, suspended solids, nitrogen, sludge index. (8)
7. oil pollution and pesticide analysis: Analysis of micronutrients, trace elements pesticides, chromatographic characterization, plolarographic and spectroscopic analysis of pesticides. (6)
8. (a)Noise Pollution and its measurements: Units, devices and map noise control system.

   (b) Radiation pollution and its measurements and control (4)
9. Instrumentation setup for different types of pollution control like wastewater treatment, HVAC control etc. (4)
10. Environmental testing, Dry heat, Dry cold, Damp Heat, salt spray, dust, altitude bump, vibration drop/topple, free fall, and study of ISO 14001. (4)

REFERENCE BOOKS:

1. Environmental pollution analysis by S.M. Khopkar, 1st edition, Wiley Eastern 1993,
2. Basic concepts of analysis chemistry by S.M. Kopkar
3. Environmental Engineering by Peary H.S. and others.
4. Sensor Systems for environmental monitoring by Cambell.
5. Basic environmental technology by J.A. Nathanson, 4th Edition, Prentice- Hall of India, Pvt. Limited, New Delhi, 2002.
6. Environmental technical series, V, I, II, III, IV, by Neal K Ustler

TERM WORK

Term work shall consist of at least eight-assignment/ programs/ tutorials based on above syllabus. Some of the assignment/programs/tutorials may be from the following list:

1. Study of procedures for Off-Line measurement of CO control in Air.
2. Study of on-line NO-Nox monitoring procedure/instrument.
3. Study of measurement of hardness of raw water.

4. Study of measurement of dissolved chlorine in industrial wastewater or treated water.
5. Study of measurement of dissolved oxygen in effluent.
6. Study of measurement of organochlorine pesticides by Thin layer chromatography.
7. Measurement of sound intensity at given location-using meter.

(8-9) Any two experiments based on above two topic (9^{th} and 10^{th} chapter)

4(iII) ADVANCED DIGITAL SIGNAL PROCESSING

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Fundamentals of DSP background and review discrete time random signals. (2)
2. Quatisation effects: - Effect of round of noise in digital filter, zero input limit cycles in fixed point realization of IIR digital filters. Effects of finite register length in DFT computations. (4)
3. Multirate digital signal processing: - Fundamentals of Multirate systems, Basic multirate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations. (10)
4. Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform, multiresolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem, (10)
5. Multirate filter banks: Maximally decimated filter banks, errors created in QMF banks, simple alias free QMF system, power symmetric filter banks, M channel filter banks, polyphase representation, PR systems, alias free filter banks, Linear phase PR QMF banks, cosine modulated filter banks, Wavelet transform and its relation to multirate filter banks, paraunitary PR filter banks, Applications of multirate signals processing narrowband LPF, sub-band coding of speech. (10)
6. Applications of DSP: Biometrics-Speaker identification and verification, face recognition, finger print verification, Applications of DSP processors in control systems and communication (one application of each). (8)

TERMWORK:

Term work shall consist of record of atleast eight assignment/tutorials/MATLAB or C Program exercises based on above syllabus. Some of the assignment/tutorials/MATLAB or C program exercises may be from the following list:

1. Write a program for estimation of autocorrelation function and estimate the autocorrelation function of random white noise signal.
2. Write a program for wavelet decomposition of 1-D discrete time signal.
3. Write a program for inverse discrete wavelet transform.
4. Write a program for speech data compression using subband coding and tabulate the results for reconstruction quality against compression ratio.
5. Write a program for K-means clustering algorithms.
6. Write a program to obtain a covariance matrix from given set of vectors.
7. Write a program to obtain eigenvalues and eigenvectors of symmetric matrix.
8. Write a program to obtain the ridge orientations in fingerprint image.

REFERENCE BOOKS:

1. E. C. Ifeachor, B. W. Jarvis, Digital Signal Processing- A Practical Approach, Second Edition, Pearson Education, New Delhi, 2002.
2. S. K. Mitra, Digital signal processing- A computer based approach, Tata McGraw Hill, 2002
3. A. V. Oppenheim, R, W, Schafer, Discrete time signal processing, Prentice-Hall of India, 2001.
4. J. G. Proakis, D. G. Manolakis, Digital signal processing –Principles, algorithms and applications, Prentice Hall of India, 2002.
5. Multirate filters and Filter banks: P. P. Vaidyanathan, PH International, Englewood Cliffs
6. Multirate signal Processing: Rabiner and Schafer, PH Inernational, Englewood Cliffs
7. Introduction to Wavelets and Wavelet Transform: C. S. Burrus, Ramesh and A. Gopinath, Prentice Hall Inc.

4(iV) EMBEDDED SYSTEMS

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. Embedded Systems (4 Hours)

Introduction, hardware/software co-design, issues in deciding where to split the problem., examples of embedded systems, sensors and interfacing techniques.

Design Challenges, Processor Technology, IC Technology, Design Technology, Trade-offs.

2. Custom Single purpose processors (3 Hours)

Hardware, Combinational logic design, Sequential logic design, Custom single purpose processor design, RT level Custom Single purpose processor design, Optimization.

3. General Purpose processors (3 Hours)

Software, Datapath, control unit, Memory, pipelining, superscalar and VLIW architectures, Programmers view: Instruction set, program and data memory space, I/O, interrupts, operating system, Development environment: design flow and tools, testing and debugging, Application specific instruction set processors (ASIPs), microcontrollers, digital signal processors, less-general AIP environments, selecting microprocessors, general purpose processor design.

4. Standard single purpose processors: peripherals (3 Hours)

Introduction, timers, counters and watchdog timers, UART, Pulse width modulators, controlling a DC motor using PWM, LCD controllers, Keypad controllers, stepper motor controllers, ADCs, Real time clocks.

5. Memory (3 Hours)

Memory write ability and storage permanence, common memory types, composing memory, memory hierarchy and cache, advanced RAM.

6. Interfacing (4 Hours)

Introduction, Communication basics, Basic protocol concepts, ISA bus protocol: memory access, Arbitration, Priority arbiter, Daisy chain Arbitration, Network oriented Arbitration methods, multilevel bus architectures, Advanced communication principles, Parallel and serial communication, wireless communication, Layering, error detection and correction, serial protocols, parallel protocols, wireless protocols: IrDA, Bluetooth, IEEE802.11

7. Digital camera example (2 Hours)

Requirement specification, design

8. State machine and Concurrent process Models: (6 Hours)

Introduction, Models and Languages, Basic state machine model: FSM, FSM with datapath model, using state machines, concurrent process model, Concurrent processes, communication among processes, synchronization among processes, implementation, dataflow model, Real Time systems.

9. Control Systems (6 Hours)

Introduction, Open and Closed loop control systems overview, Open loop and closed loop automobile cruise controller, General control systems and PID controller- Control objectives, modeling real physical system, controller design, Software coding of a PID controller, PID tuning, Practical issues related to computer based control-Quantization and overflow effects, aliasing, computation delay, Benefits of computer based control implementation.

10. Programming Languages for Embedded Systems (6 Hours)

Tools for building embedded systems - with case studies. Esterel is good for control applications / Handel-C is good for casting algorithms into re-configurable hardware, Embedded Software Development Methodology.

REFERENCE BOOKS:

1. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/software introduction, John Wiley and sons, 2002
2. D. E. Simon, An embedded software primer, Pearson Education, 2002
3. Wayne Wolf, Computers as components: Principles of embedded computing system design, Morgan Kaufman/Harcourt India, 2000
4. C. M. Krishna, Kang G Shin, Real time systems, McGraw Hill
5. Embedded Micocomputer Systems, Real time interfacing, Thomson Brooks/Cole
6. D. W. Lewis, Fundamentals of embedded software, Pearson Education
7. J. W. S. Liu, Real time systems, Pearson Education
8. Silberchatz, Galvin, Gagne, Operating system concepts, John Wiley

TERM WORK:

The termwork shall consist of a small project (implementation using any of the development environment such as Handel-C, Esterel, C/C++, Java etc.), which covers all aspects of embedded systems and some assignments as decided by subject teacher.

4(V) DIGITAL CONTROL SYSTEMS

Paper: 3 Hours, 80 marks **Class Test**: 20 marks **Term work**: 25 marks

Teaching Scheme: Lecture: 4 Hrs./Week **Practical:** 2 Hrs./Week

1. **Digital control systems** – Introduction, description of some physical systems, continuous versus digital control, Discrete-time signals, discrete time systems, sampling and reconstruction, digitizing analog controllers (6)
2. **The Z Transforms** – Definition and evaluation of Z-Transform, mapping between the s-plane and the z-plane, the inverse z-transform, theorems of z-transform, limitation of z-transform method. The pulse transfer function, pulse, transfer function of zero order hold, responses between the sampling instants, signal flow graph method applied to digital systems, stability of digital control systems, jury stability criterion (10)
3. **State variable analysis of digital control systems:** Introduction, state description of digital processors, state description of sampled continuous- time plant, state description of systems with dead time and sample and hold discrete state models using phase physical and canonical variables. Relation between state equation and transfer function and solution of state difference equations, controllability and observability (8)
4. **Pole-placement design and digital state observer:** Stability improvement by state feedback, digital control systems, with state feedback, dead beat control by state feedback, design of the full order and reduced- order state observers, linear digital regulator design (Finite time and infinite time problems) (8)
5. **Design of Sampled Data Control systems :** Descretising the differential equation of continuous PID controllers, Parameter optimized discrete control algorithms of low order, PID control algorithm through Z transformations, Deadbeat algorithm, Dahlin's algorithm, Digital Equivalent of convention controller, Smith Predictor algorithm, Internal Model control, Analytical Predictor Algorithm, Kalman algorithm, Algorithm of Gautam and Mutharasan, Treatment of noisy process signals. (10)

REFERENCE BOOKS:

1. Ogata K -. Discrete time control system Englewood cliffs prentice-Hall 1987.
2. Kuo B. C. – Digital control system 2nd edition Orlando florida saunders college publishing 1992.
3. M.Gopal- Digital control and state variable methods, Second Edition, Tata McGraw Hill 2002.
4. M. Gopal - Digital Control Engineering Wikey eastern 1988.
5. Houpls C. H. and G. B.Lamont – Digital control systems, McGraw Hill 1984.
6. P. B. Deshpande and R. H. Ash – Computer Process control with advanced control applications, Second Edition, Instrument Society of America (ISA) publications, 1988.
7. R. Iserman – Digital Control Systems, Vol.I; Fundamentals, Deterministic Control, Second Edition, springer- Verlag, Berlin, Heidelberg 1989.

TERM WORK

Term work shall consist of at least eight-assignment/ programs/ tutorials based on above syllabus. Some of the assignment/programs/tutorials may be from the following list:

1. Design and implementation of microprocessor/microcomputer based temperature control system.
2. Interfacing of ADC/DAC cards with microcomputer for data acquisition.
3. Interfacing of steeper motor with microcomputer.
4. Implementation of state feedback algorithm using MATLAB and its applications to transfer function of representative practical control system.
5. Implementation of pole placement algorithm using Ackermann's formula algorithm using MATLAB and applications to transfer function of representative practical control system.
6. Design of full order and reduced order state observer.
7. Implementation of Deadbeat and Dahalins algorithms in MATLAB
8. Design of Kalman algorithm.
9. Study and implementation of Smith Predictor algorithm.

5. PROJECT WORK-II

Subject Code	Lecture	Practical	Total	Credit
BIN 425	--	06	06	03

Term work: 100 marks **Practical:** 100 marks
Teaching Scheme: **Practical:** 6 Hrs./Week (for a batch of nine students)

PROJECT WORK-II will be the continuation of project work-I undertaken by the candidates in the first term. The term work shall consist of report of the work

carried out by the candidates in respect of the project assigned. The candidate must bring the project work-I report along with project work-II report while appearing for project work-II submission.

PRACTICAL EXAMINATION:

It shall consist of presentation and oral examination based upon the project work report submitted by the candidates and or upon the demonstration of the fabricated/designed equipment or software developed for simulation. The said examination will be conducted by a panel of two examiners, consisting of preferably guide working as internal examiners and another external examiner preferably from an industry or other university.