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SHIVAJI UNIVERSITY, KOLHAPUR.

Revised Syllabus of

(B.E. Instrumentation Engineering Sem –VII & VIII)

To be introduced from the academic year 2010-11
(i.e. from June 2010) Onwards

(Subject to the modifications will be made from time to time)

SHIVAJI UNIVERSITY, KOLHAPUR
Structure for Instrumentation Engineering Degree Course
B.E. (Instrumentation) Semesters VII & VII

Sr No.	Name of the Subject	Teaching Scheme (Hrs.)				Examination Scheme (Marks)				
--	--	L	T	P	Total	Theory	TW	POE	Oral	Total
1.	Advanced process Instrumentation	3	--	2	5	100	25	--	25	150
2.	Instrumentation system design	3	--	2	5	100	25	-	25	150
3.	Industrial Automation -II	3	--	2	5	100	25	--	25	150
4.	Digital signal Processing	4	--	2	6	100	25	--	--	125
5.	Elective I	3	--	2	5	100	25	---	----	125
6.	Project Work Phase-1 & Seminar	--	--	2	2	--	50	--	--	50
7.	Industrial Training	--	--	2	2	--	50	--	--	50
	Total	16	--	14	30	500	225	--	75	800

B.E. (Instrumentation) Part –II

Sr No.	Name of the Subject	Teaching Scheme (Hrs.)				Examination Scheme (Marks)				
--	--	L	T	P	Total	Theory	TW	POE	Oral	Total
1.	Field Instrumentation & Networks	4	--	2	6	100	25	--	25	150
2.	Process Modeling & Simulation	4	--	2	6	100	50	-	25	175
3.	Project Planning Estimation & Assessment	4	--	2	6	100	50	--	--	150
4.	Elective II	4	--	2	6	100	25	---	---	125
5.	Project Work Phase II & viva voce	--	--	6	6	--	100	--	100	200
	Total	16	--	14	30	400	250	--	150	800

Elective I
1) Virtual Instrumentation
2) Neural & Fuzzy Based Control
3) Optimal & Robust Control
4) Safety and Environmental control

Elective II
1) Power Plant Instrumentation
2) Biomedical Instrumentation
3) Advanced Digital Signal Processing
4) Embedded Systems

[Note: - Examination scheme and term work marks strictly as per above structure]

ADVANCED PROCESS INSTRUMENTATION

Teaching scheme	Examination scheme	
Lectures : 3 Hrs/week.	Theory	:100 marks
Practical : 2 Hrs/Week.	Term work	: 25 marks.
	Oral	: 25 marks

UNIT I **(3Hrs)**

Introduction:

Overview of process Control System loop components, Block diagram, Concept and need of Advanced Process Instrumentation. Process Variables & degree of freedom, dynamics & Characteristics of physical systems like electrical, liquid, thermal, gas & Mechanical processes & their influence on control system.

UNIT II **(4Hrs)**

Controller principles :

Control system parameters, steady state and unsteady state analysis control system for change in load variable & change in set point variable practical example, mathematical characterization of the components, deviation calculation. Response of process under controller actions like on/off, Proportional, integral derivative & combinational mode controllers

UNIT III **(5Hrs)**

Controller Tuning:

Tuning methods, Selection of controller block for specific operation (PID, Automan, ORSEL) for specific operation, control system selection, Initialization and bumpless transfer Case studies

Unit IV **(5Hrs)**

Digital control methods:

Direct Digital Control, Supervisory computer control, Interactive multivariable control system, Alarm & alarm management system

Case Studies: Design of Digital temperature control using digital IC's, Design of DC motor control (practical application using isolation circiutary). (System specifications, Block diagram, system design, Schematic diagram).

Unit V **(5Hrs)**

Distillation Column Control:

Equipment, C-M pairing, Energy and Material Balance Equations, Feed forward Systems, Flow Control of Distillate and Bottoms, Reflux control, Composition Control, Pressure and Temperature Controls. Constant and maximum recovery methods, distillate optimization. Application of DCS for distillation Column.

UNIT VI **(4Hrs)**

Building Automation:

HVAC and F&G , Access control

UNIT VI **(9Hrs)**

Applications:

Application of SCADA, PLC, DCS and open System for plants such as : Cement, Steel plant, Automobile, oil refinery and Water Treatment plants. (Flow-sheet Diagrams, I/O and control variables, Control Equipment, Control systems and Interlocks, Diagnostic Functions and Protections, Auto-Start-up emergency shutdown.)

Term Work

Students are expected to perform minimum 8 experiments based on above topics.

Suggested Books:

(1) Process Control Systems by F. G. Shinskey (TMH).
(2) Process Control by B. G. LIptak (Chilton).
(3) Computer Based Industrial Control by Krishna Kant(PHI).
(4) Distributed Computer Control for Industrial Automation by Popovic and Bhatkar (Dekker).
(5) Chemical Process Control by G. Stephanopoulos (PHI).
(6) Distillation Column Control by F. G. Shinskey (TMH).
(7) Process control Instrumentation – C.D. Johnson
(8)Process control designing processes and control system for dynamic processes Thomes E. narlin
(9) Analog and Digital control – Ramakant Gaikwad

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INSTRUMENTATION SYSTEM DESIGN

Teaching Scheme:	Examination Scheme:
Lectures: 3 Hrs/week	Theory: 100 Marks
Practical: 2 Hrs/week	Term Work: 25 Marks
	Oral: 25 Marks

Unit - 1 (4Hrs)

Basic Concepts on Instrumentation Design: Functional Requirements and Specifications, operational environment commercial, industrial, military. NEMA, DIN, BIS and ANSI standards with special reference to packaging, oneline diagram of hydraulic, pneumatic and electronic instrumentations system, Instruments symbols and signals.

Unit – 2 (6Hrs)

Design Aspects: Performance characteristics for flow, temperature, pressure and level transducer, smart transmitter with control capability, range, specification standards and

recommended practice for instruments, simulated technical data for design of transducer. Interface primary element with end devices, engineering display. Calibrating and testing standards for instruments and transducer. Transducer measurement and performance test (electrical, impedence, noise, resolution test and threshold test, environment and life test), measurement units current, voltage and frequency. Design of instrumentation amplifier, isolation amplifier, active filter, and Electronic circuit design guidelines.

Unit – 3 (6Hrs)
Printed Circuit Board technology: PCB materials and standards. General component layout scheme, grid system. General design guidelines for PCBs, design guidelines for analog and digital circuit PCBs, soldering techniques. Single and multilayer PCBs. Automation & computer in PCB design. Artwork & CAD packages & tools.

Unit – 4 (4Hrs)
Control valve: Effects & remedies of cavitations & Flashing. Pressure drop across the valve, valve noise, flow characteristics of linear & equal percentage control valves on load changes. Control valve selection, Seat leakage & calibration.

Unit – 5 (4Hrs)
Control panel design: Types of control panels, enclosure design guidelines grounding & shielding techniques, Electrostatic discharge (ESD), noise. design guidelines of control panel. Applications of control panel.

Unit – 6 (8Hrs)
Design Of Controllers: Selection of sensor, signal conditioning. ON-OFF and Integral, Derivative, Proportional (Electronic) controllers with digital display indicator for selected process (Flow, Level, Pressure, temperature).

Unit – 7 (4Hrs)
Reliability, MTTR, MTBF, concept of availability, component screening, Failure rate analysis, product quality variance report, control charts, SQC & TQM principles. Quality audit, safety factors & redundancy.

Term Work: the term work shall consist of at least 8 experiment assignments / sheets from design point of view based on above syllabus.

Books:

1) Electronic Instruments And instrumentation Technology, by Anand M S, New Delhi. Prentice Hall Of India, 2004.
2) Printed Circuit Boards, by walter C. Bosshart, CEDT series, TMH.
3) Process Control, by B.G.Liptak
4) Reliability Engineering, by E. Balguruswamy.
5) Measurement Systems by E. O. Doebline.
6) Noise Reduction Techniques- Ott H W
7) Electrostatic Discharge and Electronic equipmwnt by Warren Boxleitner, IEEE press
8) Industrial Process Control by Jocob
9) Process Control for Industries by Andrew Williams.
10) Smart Sensors (ISA)

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INDUSTRIAL AUTOMATION - II

Teaching scheme	Examination scheme	
Lectures : 3Hrs/week.	Theory:	100 marks
Practical : 2Hrs/Week.	Term work:	25 marks
	Oral:	25 marks.

1. Review: (1 hrs)
   Automation terms, options, standard architectures, functional levels, data bases, and programming standards.

2. Batch Control System Automation : (2 hrs)
   Introduction to Batch processing, batch control types & components.
   Batch control system terminology & characteristics of batch processing.
   The hierarchical batch model & control structure.

3. Batch Control Systems Engineering & Management: (6 hrs)
   General control requirements, safety interlocking, sequential control of batch processes, batch & recipe management. Case studies of use in Pharma & Dairy processing.

4. State of the Art in Batch Control Systems: (3 hrs)
   Batch control standards, recipes, computer aided formulations, electronic batch recorder & signatures, batch control optimization, batch control system selection criteria.

5. Distributed Control Systems components: (5 hrs)
   Concepts of hierarchical control.
   Workstation & Workstation Hosts: issues, Design concepts & classification.
   Operator Interface evolution & HMI design. Networks in process automation, Fault-tolerant programming & real-time operating systems.

6. Vendor Architectures & Applications: (8 hrs)

Popular DCS Architectures & specifications for Honeywell's TDC 3000 & EPKS, Siemens S7400H, Rockwell ControlLogix, Emerson's DeltaV & Ovation, Yokogawa CENTUM CS3000 and ABB's system 800XA.

Case studies of Industrial use oil & gas fields and biotechnology plants.

7. DCS Systems Engineering: (4hrs)
   Justification, Detailed specification, Evaluation & Implementation. Upgrading Control Rooms.

8. State of the art in DCS: (6 hrs)
   Integration of DCS, PLC, HMI & SCADA systems.

Integration with RTUs, Multiplexers, fieldbuses & Data Highways.
Hybrid systems with discrete & analog capability.
Sequence of Event recorders & post-trip reviews.
OPC software architecture.

Term work: Term work will consist of at least Ten experiments on DCS, BCS, PC, SCADA with interfacing, practical examples and assignments.

Suggested Books:

1. Batch Control Systems: Thomas G Fisher, ISA Press.
2. Distributed computer control for Industrial Automation: Popovic & Bhatkar, Dekker.
3. Understanding Distributed processor systems for control - smuel Herb, ISA.
4. Process software and Digital Networks. Bela Liptak, CRC Press.

DIGITAL SIGNAL PROCESSING

Teaching scheme	Examination scheme
Lectures: 4 Hrs/week.	Theory: 100 marks
Practical: 2 Hrs/Week.	Term work : 25 marks

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UNIT I

Discrete Transforms: (08Hrs.)

Discrete time Fourier series, Discrete Fourier transform and its properties, circular convolution, Fast Fourier transform: Radix-2, DIT FFT algorithm, Radix-2 DIF FFT algorithm, Inverse Fourier transform, Block convolution-overlap save, overlap add, linear convolution using DFT AND IDFT.

UNIT II

Wavelet transformer: (06Hrs.)

Introduction to wavelet transformer, Time Frequency decomposition, STFT, CWT, ICWT, DWT, IDWT, Application of wavelet transform.

UNIT III

Realization of Digital Linear systems: (06Hrs.)

Basics of digital filtering, elements of digital filter, filter stability on placement of poles, types of digital filters, Realization of digital filters, direct form-I, direct form-II, cascade form, Parallel form etc.

UNIT IV

FIR digital filter: (08Hrs.)

Characteristics of FIR digital filter, Properties, frequency response linear phase, Design of FIR filter using Fourier series, frequency sampling, window method, Finite word length effect coefficient quantization round off errors, overflow errors.

UNIT V

IIR digital filter: (08Hrs.)

Basic features of IIR filter comparison IIR with FIR filter. Design of IIR filter using impulse invariance method, bilinear transformation method, pole zero placement method, matched z-transform method, finite word length effect in IIR filter design, Quantization error.

UNIT VI

DSP Applications: (06Hrs.)

Adaptive Telephone echo cancellation, fetal ECG monitoring, evoked potential Analysis, speech synthesis and reorganization. Application related to instrumentation and biomedical signal processing.

Term work: Term work shall consist of at least eight experiments/ assignments based on above syllabus.

Reference books:

1. J. G. Proakis and D. G. Manolakis- Digital signal processing - Principles algorithms and Application. PHI publication.
2. A.V. Oppenheim and R.W. Schaffer, Digital signal processing, PHI publication.
3. T.J. Terrel and Lik Kwan-Digital signal processing.
4. D.J.Deffatta-Digital signal processing - A system design approach.
5. E.C. Ifeachor and B. W. Jervis - Digital signal processing - A practical approach.
6. S.K.MITRA “digital signal processing-A computer based approch”Tata McGraw Hill ,2002

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VIRTUAL INSTRUMENTATION

(Elective – I)

Teaching Scheme	Examination Scheme
Lecturers : 3 Hrs / week	Theory : 100 marks
Practicals : 2 Hrs / week	Term work : 25 marks

UNIT-I (6Hrs)

Review of Virtual Instrumentation : Historical perspective, Need of VI, Advantages of VI, Define VI, block diagram & architecture of VI, data flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II (5Hrs)

Programming Techniques : VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input.

UNIT-III (6Hrs)

Data Acquisition basics : ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation.

UNIT-IV (6Hrs)

Common Instrument Interfaces : Current loop, Rs 232C/Rs 485, GPIB, System basics, interface basics : USB, PCMCIA, VXI, SCXI, PXI etc, networking basics for office & industrial application VISA & IVI, image acquisition & processing, Motion Control.ADC,DAC,D10,DMM,Waveform generator

UNIT-V (5Hrs)

Use of Analysis Tools : Fourier transforms, Power spectrum, Correlation methods, windowing & flittering.

UNIT-VI (6Hrs)

Application in process control projects. Major equipments – oscilloscopes,digital multimeter,Pentium computers,temperature data acquisition system,motion control employing stepper motor

Term work : The termwork shall consist of at least 8 assignments/ tutorial using labview graphical programming.

Recommended Text Books :

1. Gary Johnson, Labview Graphical Programming second edition, MC GrawHill, Newyork, 1997
2. Lisa K. Wells & Jettrey Travis, Labview for everyone, Prentice Hall, New Jersey, 1997.
3. Sokoloff, Basic Concepts of Labview 4, Prentice Hall, New Jercy, 1998.
4. S. Gupta, J.P.Gupta, PC interfacing for Data Acquisition & process control, second Edition, Instrument Society of America, 1994.
5. Technical manuals for DAS modules of national instruments

L .T.amy Automation system for control & data acquisition.

NEURAL AND FUZZY BASED CONTROL

(Elective – I)

Teaching scheme	Examination scheme
Lectures : 3 Hrs/week.	Theory :100 marks
Practical : 2 Hrs/Week.	Term work : 25marks.

UNIT-I (8Hrs)
Artificial neural systems : Preliminaries, fundamental concepts & models of artificicalsystem, neural networks learning rules, Hebbian, perceptron, delta Widrow-Hoff learning rules.
Single layer perception classification : Classification model, features & decision regions training & classification using discrete perception, algorithm & examples, single layer continuous perceptron networks for linear separable classification.

UNIT –II (6Hrs)
Multilayer feedback work networks : Generalized delta learning rule, feedforward recall & back propagation training learning factors.
Single layer feedback networks : basic concepts of dynamical systems mathematical of discrete time & gradient type Hopfield networks, transient response of continuous time solution optimization problems.

UNIT -III(6Hrs)
Neural network in control system : neuro-control approaches, training algorithm evaluated training algorithms, through simulation, self tuning neuro-control scheme, self tuning PID controller, neuro-control scheme feed water bath temperature control system.

UNIT –IV (6Hrs)
Basic concepts of fuzzy sets- Relation equation – fuzzy logic control – fuzzification – defuzzification – knowledge base – Decision making logic – membership function – rule base.

UNIT-V(8Hrs)
Fuzzy logic controller: functional diagram, membership function: triangular,trapezoidal-scal factors.fuzzyfication: membership valu assignments using intuiyion – knowledge base. Defuzzyfication: max membership principle – centroid method – weighted average method-rule.choice of variables-derivation of rules – case study: fuzzy logic controller design for a temperature process

Term work: Term work shall consists of at least eight experiments based on above topics a using MATLAB or similar software package.

Books :

1. Introduction of artificial neural systems J.M.ZURADA Jaico publication House 1997
2. Neural networks : comprehensive foundation S.IIAYKIN McMillian College Publishing company inc. 1994
3. Neuro control and its application S.OMATU, M.KIIALID, R.YUSOF. Spring Verlag London Ltd. 1996.

4. An introduction to fuzzy control D.DRIANKOV, H. HELLENDOORN and M REINFRANK Narosa Publication House, 2nd reprint 1997.
5. Neural Network Design, Hagan, Demuth Deak Thomson Learning
6. Neuro-fuzzy and soft computing, PHI publication
7. Fuzzy logic : Intelligence control and Information, John Yen Pearson publication.
8. Kosko B : Neural network & fuzzy systems- phi pvt ltd.

OPTIMAL AND ROBUST CONTROL

(Elective I)

Teaching scheme	Examination scheme
Lectures : 3 Hrs/week.	Theory :100 marks
Practical : 2 Hrs/Week.	Term work : 25 marks

1. **Introduction:** (4Hrs) Differential operator, state-space and transfer function models, dynamic response, Bode and Polar plots.
2. **General control and stability:** (07Hrs) The primary transfer functions, one and two degree of freedom configurations, the one degree of freedom restriction, the loop gain and the return difference, nominal closed loop stability. The Routh harwitz'scriterion. The Nyguist stability criterion.
3. **Loop Goals:** (06Hrs) Robust stability for plant parameter variations, robust stability for unmodified dynamics, disturbance rejection and noise attenuation, robust loop goal performance.
4. **Response Goals:** (06Hrs) Output regulation, the transient tracking response, the steady state tracking response.
5. **Classical control Techniques:** (06Hrs) PID compensation, lag and lead compensation.
6. **Modern control Techniques:** (06Hrs) Linear state variable feedback, observers, optimal error dependent pole placement, optimal LQR compensation.

Term Work : The term work shall consists of at least eight experiments based on the syllabus using MATLAB or similar software packages.

Suggested books:

1. W.A.Wotovich Automatic control systems. International Edition, saunders college publishing, Harcourt brace college Publishers, New Yark. 1994.
2. K. Ogala Modern control Engineering 4th Ed 2002, Eastern Economic Edition, PHI Ltd.

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SAFETY & ENVIRONMENTAL CONTROL

(Elective-1)

Teaching Scheme	Examination Scheme
Lectures: 3 Hrs/week	Theory: 100 Marks
Practical : 2 Hrs/week	Term work : 25 Marks

1. Safety - Concept and Need of Safety, Safety and Industries - Definition, Various Hazards in Industries, Need of Industrial Safety, Safety Department and its Role, Good House Keeping (2 Hrs)

2. Introduction to Risk Assessment & Management, Safety Management Systems, OSHAS 18001 management system and Auditing, , Product Safety, Accidents in Industries, Definition and Various Causes, Accident Theory, Cost of Accidents, Accident Prevention Techniques. (4 Hrs)

3. Environmental definition, Constituents, biochemical cycle, causes of pollution, types of pollution and their measurement, effects of pollution, different sensors for measurement of pollution, difference between off-line measurement and continuous monitoring. (3 Hrs)

4. Environmental toxicology and hazards. Common toxic agents, their analysis and safety measures, environmental regulation and standards, Review of standard methods of Pollution analysis, Sampling Operation, Devices and techniques as related to environmental engineering. (3 Hrs)

5. Air Pollution Analysis: Analysis of aerosols and Monitoring of gaseous pollutants like S02, H2S, NO-Nox, CO-CO2, ozone, NH3 and organic gases, vapor Analysis Monitoring of suspended particulate matter and trace metal pollutants. (3Hrs)

6. Water Pollution Analysis Physical Examinationcolour, conductivity, temperature, odour, turbidity, hardness. Chemical Characterization - Ca 2+, Mg2+, Na+, C I-, S04+ 2-, HC03-, AI3+, Ba2+Boron, F-, N02-, P04 3-, Fe3+ Mn2- Sio2 2-, Biological investigation - no, BOD, bacteriological examination, types of Wdlcr quality monitoring instrumentation. (pH meters, conductivity meters etc.).
Waste water sources, Characterization & composition of wastes, Manufacturing process & flow sheet and Treatment flow sheet in Major industries such as
a) Agrobased industries - Sugar, Distillery, Dairy, Textile, Paper & Pulp etc.
b) Chemical based industries – Fertilizer, Paints, Petroleum, Refinery, Pharmaceuticals, tannery
c) Mechanical/Manufacturing industries – Steel, Foundry, Automobile, Plating etc.
d) Food Processing industries – Canning (5 Hrs)

7. Effluent Analysis: Physical Methods of characterization: density, viscosity, temperature, conductivity, turbidity, volatile, and dissolved solids, oil and immiscible liquids, colour odour, radioactivity. analysis of organic pollutants. BOD, COD, TOC Specific analysis of Organic pollutants, analysis of metal pollutants, Analysis of anion and dissolved gases

dissolved oxygen, pH, dissolved chlorides, suspended Solids, nitrogen, sludge index.
(4 Hrs)

8. Soil Pollution and pesticide Analysis: Analysis of Micronutrients, trace elements pesticides, Chromatographic Characterization, Polarographic and Spectroscope Analysis of pesticides. (3 Hrs)

9. a) Noise Pollution and its Measurement: Units Devices and maps Noise Control System.
b) Radiation Pollution and its Measurement and Control.
(3 Hrs)

10. Instrumentation setup for different type of Pollution control like wastewater treatment, HVAC control etc. Environmental testing, Dryheat, Drycold, Damp Heat, Salt Spray, Dust, Altitude bump, Vibration drop/ Topple, free fall, and study of ISO 14001.
(5 Hrs)

Term work:

Industrial visits and report on -

a) Industrial Safety
b) Environmental Management System

Books

(1) Environmental Engineering by Gerard Kiely

(2) Environmental Engineering by Howard Peavy,Donald R. Rowe,George Tchobanoglous.

(3) Environmental Management By G.N. Pandey

(4) Environmental Pollution Control by C.S. Rao

(5) Basic Concepts of Analysis Chemistry by S. M. Khopkar.

(6) Environmental Engineering by Peary H. S. and others.

(7) Sensor Systems for Environmental monitoring by Campbell.

(8) Basic Environmental Technology: (Ed. 1997) by J. A. Nathanson.

(9) Environmental tech. Series, V, I, II,III, IV by Neal K. UstIer.

(10) Occupational Safety and health -by David L. Goetsch, Prentice Hall, Ohio

(11) Safety manual - EDEL Engineering consultancy Pvt. Ltd.

(12) Hazardous Material and Hazardous Waste management - by Gayle Woodside, John Wiley &sons Inc.

(13) Environmental Health and Safety Auditing Handbook - by Lee Harrison, Mac Graw Hill Inc.

(14) Industrial and Occupational Safety, Health & Hygiene - by Dr. A.H. Hommadi

(15) Introduction to Industrial Safety - by K.T. Kulkarni

(16) Waste water treatment - M.N.Rao & Datta.

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PROJECT WORK PHASE-I & SEMINAR

Teaching scheme: Examination scheme:
Practical: 2Hrs/Week Termwork:50 marks

The students are expected to take up a Project/seminar Topic under the guidance of a faculty from the Institute &/ possible industrial sponsors. The Project/seminar Topic selected should ensure the application of acquired theoretical & practical skills in Instrumentation engineering. It should aim to satisfy the urgent need to establish a direct link between technical education, national development and productivities.

The students may be asked to work individually or in a group having not more than FOUR students. The student/group of student shall survey & collect all necessary information from various sources on the selected topic/project. It includes defining the scope of project, problem analysis, identification of necessary data/equipment/hardware & software, and development of overall/detailed design for implementation. Each Student will deliver a seminar on the selected Project/topic. The student is expected to submit the report in standard specified format .

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INDUSTRIAL TRAINING

Teaching Scheme Examination Scheme
Practical: 2 Hrs/week Term work: 50 Marks

It consist of assessing the Industrial Training (and training report) under taken by the students at the end of 6^{th} semester.
Guidance activities will be conducted with experts from industry, Govt./NGOs/ other professional agencies & academicians doing research. The focus will be on project work, placement in industry, career roles of Instrumentation engineers, conduct of research work & on becoming entrepreneurs.

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BE INSTRUMENTATION – I I

FIELD INSTRUMENTATION & NETWORKS

Teaching scheme
Lectures : 4Hrs/week.
Practical : 2Hrs/Week.

Examination scheme
Theory: 100 marks
Term work: 25 marks
Oral: 25 marks.

1. Introduction to Networks & Fieldbus: (8hrs)

Proprietary & open networks. Hardware selection for Fieldbus systems .Sorting the protocols.

Fieldbus trends, Advantages & Disadvantages, Design, installation, economics & documentation.

2. Hart Networks: (7hrs)
   Hart protocol, field Devices, calibration, Hart applications, installing Hart Networks, Device Descriptions and Applications. Wireless Hart.

3. Foundation Fieldbus Networks: (7hrs)
   Standards, field bus Architecture and user Layer, H1 & HSE specifications, Segment design.

4. Profibus Networks: (4hrs)
   Basics, Block Model, Applications, Network Design, system configuration and Developments. Profibus PA & DP specifications. Segment design.

5. Fiber-Optic Networks: (2hrs)
   Principles, Types of Cables, Network Design, installation finishing, inspection and Testing. Modulation/Demodulation techniques.

6. Wireless Networks: (7hrs)
   Radio system, cellular Telephony, wireless Data, Satellite LANS, Infrared systems and operating procedures. Wireless transmitters & their architecture.

7. Specific Fieldbus Networks: (4hrs)
   Device Net, control Net, Lonworks, world FIP, Actuater sensor, Interface.
   Propritary Networks: Modbus, data highway, Genius Bus.

8. Network Installation & Security:
   (7hrs)
   Physical security, security policies, Encryption, Identity verification, OS security, Login and password security, protection from viruses, preventive measures, internet access, Digital certificates, Network security with Firewalls. Configuring routers & switches.

Term work: The term work shall consist of at least Ten Experiment based on above topics.

Suggested Books:

1. Process software and Digital Networks: Bela Liptak, CRC process.
2. Understanding Distributed Process system for control samnel Herb, ISA.
3. Introduction to Networking Richard McMahon, TMH.
4. Networking A beginner's Guide: Bruce Hallberg, TMH.

PROCESS MODELLING AND SIMULATION

Teaching scheme
Lectures : 4 Hrs/week.
Practical : 2 Hrs/Week.

Examination scheme
Theory : 100 marks
Termwork:50 marks
Oral: 25 marks.

UNIT I (3Hrs)

Introduction:

Introduction to process control, control objectives and benefits,Dynamic behavior of process control systems: Dynamic behavior of first second order system, series and parallel structures of simple system, Recycle structures, staged processes.

UNIT II(14hrs)

Concepts of system modeling:

Definition, principles of system modeling, modeling procedure, need of modeling, for engineering and non –engineering systems, Classification of modeling, fundamentals of chemical process dynamics, continuity equation, equation of motion, transport equation, equation of state, equilibrium, chemical kinetics, Input-output model and its transfer function, Dynamic modeling of tank reactor system. Vaporizer flash drum, batch reactor, Binary distillation column, boiler.

UNIT III(4Hrs)

Computational methods for solving algebraic & differential equations:

Solution of algebraic equation: Interval Halving, Newton Raphson method

Solution of differential equation: Runge-Kutta method, Euler method, Adam-Bash forth method

UNIT IV(5Hrs)

Empirical model Identification:

Empirical model building procedure, process reaction curve method, statistical model Identification.

UNIT V(4Hrs)

Intelligent controllers:

Adaptive control system (Self tuning regulator & Model reference adaptive controller), Inferential control systems, Optimal controller using Kalman filter, predictive controller.

UNIT VI (5 Hrs)

Optimization:

Optimization techniques and application, Single and multivariable optimization, line programming , Sequential quadratic programming & reduced gradient optimization technique & application, Introduction to geometric programming and dynamic programming.

UNIT VII (6Hrs)

Simulation:

Basic principles of simulation, use of system simulation, tools for modeling & simulation, types of system simulation. analog & digital simulation techniques, process simulation, control system simulation, formulation of model for dynamic system & simulation on analog computer.

Termwork: Students should perform at least eight assignments / tutorials based on above syllabus using MATLAB or similar software package.

Suggested books:

1. Process control: Thomas E. Marlin, Mc Graw Hill Publication.
2. Chemical process control: Geoye stephanppolous, PHI private Limited
3. Process modeling, simulation and control for chemical Engineers William L. Luyben, MC-Graw Hill Private Ltd.
4. Computer based Industrial control- Krishna Knt.
5. Practical process Instrumentation & control – J Matley (mn)
6. Chemical process simulation – Asghar Hussain
7. System simulation – Geoffery Gorden
8. System simulation with digital computer – Narsing Deo
9. Introduction to simulation – James Payne (MN)
10. Simulation modeling & analysis – Law Kelton (MN)
11. Simulation – A problem solving approach
12. Mat LAB & similink references.
13. Control system Engg. – Norman Nise
14. Chemical Process control theory & application – Gould
15. OPTIMIZATION OF CHEMICAL PROCESS- EDAGAR AND HIMMELBLAU.

PROJECT PLANNING ESTIMATION AND ASSESSMENT

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/week	Theory Paper: 100 Marks
Practical: 2 Hrs/week	Term work: 50 marks

UNIT-I (4Hrs)

Project Engineering: Definition of Project, Project objectives, need, scope, Project implementation and cost estimation, activity v/s documents, time scheduling, quality and organization structure.

UNIT-II (4Hrs)

Basic and detailed engineering: Degree of automation, manpower consideration, interdepartmental and interorganisation interactions, Multi Agency Interaction.

UNIT-III (4Hrs)

Project Engineering and Documentation: Document system, Process flow sheets, standard symbols and legends, P and I diagrams, Instruments list, instrument index sheets, instrumentation and Controls specification sheets, ANSI/ISA standards for instrument identification.

UNIT-IV (8Hrs)

Detailed Engineering and Documentation: Plant layout drawing, loop schematics and termination diagrams, hook up diagrams, wiring diagrams, interlock diagrams, isometrics, installation sketches and bill of material, Control panel diagram, Instrument data sheet, check list, legend sheet, test and progress report, control system documentation.

UNIT-V (4Hrs)

Cable Engineering: Different types of cables and tubing sizes and specifications, glanding and termination, need for junction boxes, laying cable and tubing.

UNIT-VI (4Hrs)

Installation Practice for common instruments: Pressure gauge, temperature indicator and element, rotameter, orifice assemblies, d. p. transmitter, pH electrode, control valve etc.., Equipment level automation and role of hydraulics, pneumatic electronic devices and systems. Power/air distribution system.

UNIT-VII (4Hrs)

Project monitoring: PERT/CPM techniques, project bar chart, network diagram, fixing critical path, project evaluation and review techniques, Procurement activities-tendering, document review and approval, bid evaluation and purchase, inspection and testing.

UNIT-VIII (6Hrs)

Test procedure, Installation, commissioning and Construction activities: Factory acceptance and site acceptance test, on site inspection report, front availability, installation and commissioning activities and documentation, loop checking and commissioning instruments and control systems, installation sketches, bill of material, contracting, cold commissioning and hot commissioning, testing, trouble free start ups, post installation maintenance, spare management, annual maintenance contract.

Term work: Term work shall consist of visiting to one of process industry and prepare all related documentation (8 to 10 document sheets)

Suggested books:

1. Distributed Computer control for Industrial automation - Popovic and Bhtkar (Dekker).
2. Process Control - B.G.Liptak (Chilton)
3. Computer based Industrial control - Krishna Kant (PHI).
4. Microprocessor Based Process Control - C.D. Jhonson.
5. Process control Instrumentation Technology - C.D. Jhonson (4^{th} Ed)
6. Programmable Logic controller - J.D.Otter (PHI).

7. Industrial Programmable Controller (ISA).
8. Applied Instrumentation – Andrews Williams

POWER PLANT INSTRUMENTATION

(Elective – II)

Teaching scheme	Examination scheme
Lectures : 4 Hrs/week.	Theory :100 marks
Practical : 2 Hrs/Week.	Term work : 25 marks

1. Thermal Power Plant- (6 Hrs)

   Method of power generation, layout and energy conversion process, Types of Boilers, Types of Turbines, Types of Generators, Types of pumps and Fans; Material handling system, study of all loops- water, steam, fuel etc.

2. Hydroelectric Power Plant- (6 Hrs)

   Site selection, Hydrology, Estimation electric power to be developed, classification of Hydropower plants, Types of Turbines pumped storage plants, storage reservoir plants.

3. Comparison of Thermal and Hydro Power Plant – (5 Hrs)

   Performance, efficiency, site selection, Economics-capital and running, safety standards, pollution, effluent management and handling.

4. Non conventional Energy Power Plant: (8 Hrs)

   Wind, solar, sea tide, Nuclear, Geothermal, MHD, Biomas cogeneration Problems in Harnessing these energy sources.

5. Parameter measurements: (6 Hrs)

   Electrical Parameter measurement and control, current, voltage, power, power factor, frequency, Trivectormeter. Non electricalfuel, flow, level, Air steam, temperature, pressure.

6. Thermal Power Plant Instrumentation: (6 Hrs)

   Control and monitoring of combustion process Air to fuel ratio, three element drum level, temperature, pressure, furnace draft, air, water, exhaust gas, Burner management system, Automation strategy of power plant, Block diagram, control equipment, protections, Governors.

7. Turbine Instrumentation: (5 Hrs)

   Speed calculation, valve actuation, Thermal stress control, vibration, eccentricity, axial shift various control loops and interlocks.

   Alternator Instrumentation Generator cooling systems, Hydrogen charging & Discharging systems.

8. Pollution monitoring and control: (3 Hrs)

Sound, Air, smoke, dust, study of Electrostatic precipitator

Term work : The term work shall consists of the report submitted by student on visit to power plants which is organized to impart first hand demonstration of Instrumentation system of power plants.

Books:

1. Power Plant Engg.: Domkundwar
2. Process Control: Liptak
3. Energy Management Handbook: W.C. Taeruer
4. Pollution: M.N.Rao and H.V. Rao.
5. Power system control Technology – Torsten Cegrell (PMI)
6. Energy Technology Handbook, considine D.M.(MHR)
7 Solar Energy Technology vol I & II Dickinson & cheremision off.
8 Computer control & modeling- krishnkant.

BIOMEDICAL INSTRUMENTATION

(Elective-II)

Teaching Scheme	Examination Scheme
Lectures: 4 Hrs/week	Theory: 100 Marks
Practical's: 2 Hrs/week	Term work : 25 Marks

1. Introduction to Human Anatomy: (05Hrs)

Cell structure, basic cell functions, origin of bio_ potentials, and electrical activity of cells, types of electrodes.

Physiological parameters & suitable transducer for its measurement, its operating principle.

2. Physiological Systems (08Hrs)

Cardio-vascular system: Structure of heart, cardiac cycle, ECG theory, blood pressure measurement, blood flow measurement.

Central nervous system: Structure of neuron, different waveform generation, EEG theory, Evoked response.

Respiratory system:-Natural process of breathing, Spiro meters, air flow measurement, Oxygenators, Ventilator, Artificial respiration.

3. Recording & Monitoring Instruments (08Hrs)

Life saving Devices: Pacemaker, Defibrillator, Artificial Heart valves, Heart lung machine.

Imaging techniques: Telemetry, C.T, Endoscopy, and Sonography.

Cardiac arrhythmias & ambulatory monitoring System.

4. Bio potential Amplifiers: (04Hrs)

Designing of Instrumentation Amplifier, CMRR improvement Technique, IC based instrumentation Amplifiers, Isolation Amplifiers, Isolated power Supplies and their Applications.

5. **Clinical lab Instrumentation**:- **(05Hrs)**

Blood component & there function Blood cell counter, Glucose measurement technique, Urine analysis technique- PH electrode, PO2 Electrode, PCO2 electrode. Diathermy Machine.

X-ray machine: Introduction, Types, operation, Application.

6. Safety Measures: (04Hrs)

Electrical Safety: Macro shocks, micro shocks, Significance of Electrical Danger, ground shock hazards, methods of Accident Prevention, line isolation system.

7. Recent Development in Biomedical Instrumentation: (07Hrs)

Kidney Instrumentation: Kidney structure, Regulation of water & Electrolyte balance, Artificial Kidney Types, Dialysis system.

Laser Instrumentation: Laser Based Surgical Devices, Instrumentation in Cryogenic, Instrumentation in MRI, Wireless biosensors for health monitoring.

Termwork:

1. Visit to Well Equipped hospital. Prepare detail report on it.
2. Measure Diastolic & systolic blood pressure by using Spagmomanometer.
3. Study of ECG, EEG Waveforms
4. Design of Bio Instrumentation Amplifier
5. Design Signal Conditioning Circuits with Amplifiers to measure Human body parameters.

Reference Books:

1. Carr & Brown,' Introduction To Biomedical Equipment Technology'
2. R. S. Khandpur,' Handbook of Biomedical Instrumentation', TMH.
1. Jacobsons & Webster,' Medicine and Clinical Engineering', PHI
2. Cromwell,' Biomedical Instrumentation and Measurements', PHI
3. Bronzino,' The Biomedical Engineering Handbook', IEEE Press
4. Feenberg,'Applied Chemical Engineering'
5. K. Kirk Shung, Michael B. Smith, Benjamin Tsui 'Principles of Medical Imaging',-Pub: Academic Press.
6. Carruth,' Medical Laser Applications'
7. Sliney & Trokal,'Medical Lasers & their safe Use'
8. Human Physiology: The Mechanism of Body Function by Vander, Sherman, TMH Ed.
9.Biomedical Digital Signal Processing by Tompkins.
10.Lithotripsy.

ADVANCED DIGITAL SIGNAL PROCESSING

(Elective-II)

Teaching scheme Examination scheme

Lectures: 4 Hrs/week. Theory: 100 marks
Practical: 2 Hrs/Week. Term work: 25 marks

UNIT-I

Adaptive Signal processing: (08 Hrs.)

Basic of adaptive filtering, adaptive direct form FIR filters, lest means square algorithm, RLS algorithm,

Echo cancellers: multi rate filters, QMF, fuzzy signals-signal description, network implementation, neuro-fuzzy processing of signals.

UNIT-II

Multirate Signal Processing: (06 Hrs.)

Introduction, decimation by a factor D, Interpolation by a factor I, sampling rate conversion by a rational factor I/D, filter design & implementation for sampling rate conversion, multistage implementation of sampling rate conversion, sampling rate conversion of band pass signals, sampling rate conversion by an arbitrary factor, application.

UNIT-III

Statistical Digital Signal processing. (06 Hrs.)

Introduction, Random process, random signal, Statistical properties of random signal, power density spectrum,DTFT of the cross correlation sequence, estimation of autocorrelation,periodogram,use of DFT in power spectrum estimation, performance characteristic of nonparametric power spectrum estimation

UNIT-IV

Digital Signal Processor (14 Hrs.)

Hardware architecture, introduction to fixed point and floating point, DSP proecssors, architecture features of TMS320C67XX: computational units, bus architecture and memory, data addressing, address generator unit, programme control, programme Sequencer, pipelining, interrupts, features of external interfacinf,on-chip peripherals, hardware timers, host interface port, clock generator, SPORT.

UNIT-V **(10 Hrs.)**

Programming of TMS320C 67XX

Instruction set of TMS320C67XX, programme using TMS320C67XX e.g. wave generator, matrix multiplication,3 sample average program on pipeline operation,DFT,FIR,IIR

Term work: Term work shall consist of at least eight experiments/ assignments based on TMS320C67XX processor kit

Reference books:

1. J. G. Proakis and D. G. Manolakis- Digital signal processing - Principles algorithms and Application. PHI publication.
2. A.V. Oppenheim and R.W. Schaffer, Digital signal processing, PHI publication.

3. T.J. Terrel and Lik Kwan-Digital signal processing.
4. D.J.Deffatta-Digital signal processing - A system design approach.
5. E.C. Ifeachor and B. W. Jervis - Digital signal processing - A practical approach.
6. S.K.MITRA “digital signal processing-A computer based approch”Tata McGraw Hill ,2002
7. TMS 320C67XX DSP manual.
8. DSP Processors fundamentals architecture and features,Piscataway,N.J.IEEE,1997, LAPSLEY P.,Bier j.,shohan A,Lee E.a.

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EMBEDDED SYSTEMS
(ELECTIVE – II)

Teaching scheme	Examination scheme
Lectures: 4 Hrs/week.	Theory: 100 marks
Practical: 2 Hrs/Week.	Term work: 25 marks.

Unit 1: Introduction to Embedded systems: (5Hrs)

Processor in Embedded system, Hardware units, Software embedded into a system, Process of selection for embedded system, memory and I/O devices, interrupt servicing mechanism, interrupt latency, context switching.

Unit 2: ARM Processor: (7Hrs)

CISC and RISC processors architecture, ARM organization, ARM Programmers model, operating modes, Nomenclature, Core Extensions . ARM Design Philosophy, Embedded System Hardware, Embedded System Software, and ARM Processor Fundamentals: Registers, Current Program Status Register, Pipeline Exceptions, Interrupts and the Vector table, ARM 7 families, Introduction to ARM 7/ ARM 9. AMBA Bus architecture.

Unit 3: ARM Instruction Set: (7 Hrs)

Introduction to ARM and Thumb instruction set, Data processing instructions, branch instructions, load-store instructions, software interrupts instructions, program status register instructions, stack instructions and conditional execution. Assembly language programming. ARM (32 bit) and THUMB (16 bit) operating modes. Switching between ARM and THUMB instructions

Unit 4: Exception and Interrupt handling :(4Hrs)

Exception types in ARM, exception handling, External interrupt, software interrupts handling, abort handling .Memory management unit (MMU), Virtual memory, multitasking and the MMU, Page tables, Translation Look Aside Buffer, Fast Context Switch Extension

Unit 5: Real Time Operating System: (7 Hrs)

Operating system services, Real time and embedded system OS. Types of RTOS hardware & software RTOS. Scheduling policies, priority round robin, effective release time and dead line, clock driven approach. Preemptive Kernel, Non preemptive Kernel, monolithic versus micro kernel, priority inheritance protocol, priority ceiling protocol. Messages, queues, mailboxes and paper, timer function, events, memory management, interrupt basic system design using RTOS, task structures and priority.

Unit 6: RTOS Programming Tools: (5Hrs)

Overview of Commercial RTOS like VxWorks, RTLINUX, MUCOS, QNX, Software development cycle.

Unit 7: Example of Embedded system design: (5Hrs)

Problem specification, resolving timing problem, use of an RTOS, work division into tasks dealing with shared data, encapsulating semaphores and queues, saving space and power.

Case study of embedded systems like Automatic Vending Machine and Adaptive control system in car.

Term Work :

Student should perform at least eight practicals from following list

1. Simulation software of ARM processor

2. Study of Timers of ARM

3. Interfacing of LEDs to ARM board

4. Interfacing of LCD to ARM board

5. Interfacing of keyboard and LCD to ARM board

6. Analog to Digital Converter with ARM

7. Digital to analog Converter / PWM with ARM

8. Implementation of I2C protocol

9. Implementation of SPI protocol

10. Implementation of USB protocol

Reference Books:

1. Andrew Sloss, Dominic Symes, Charis Wright ,"ARM Developers Guide".
2. Raj Kamal ,"Embedded Systems Architecture Programming, Design".
3. Frank Vajid,"Embedded system design",PHI
4. David Simon, "Embedded Systems software primer", Pearson

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PROJECT WORK PHASE II & VIVA VOCE

Teaching scheme
Practical: 6 Hrs/Week.

Examination scheme
Term work: 100 marks.
Oral: 100 marks

The term work will consist of continuous assessment of project work allotted to the students in project work phase I. It may be Department /Industrial Sponsored/ self defined. The project will be designed, fabricated and tested & presented to the Guide & staff. The marks will be based on the project activities, oral examination and project report.

EQUIVALENCE FOR B.E. (Instrumentation)

Sr. No.	Pre-revised subjects	Sr. No.	Revised subjects
1	Process Instrumentation - II	1	Advanced Process Instrumentation
2	Instrumentation system design	2	Instrumentation system design
3	Digital signal Processing	3	Digital signal Processing
4	Advanced Industrial Automation	4	Industrial Automation -II
5	Elective I	5	Elective I
6	Project Design & Seminar	6	Project Work Phase-1 & Seminar

B.E. (Instrumentation) Part –II

Sr. No.	Pre-revised subjects	Sr. No.	Revised subjects
1	Intelligent Field Instrumentation	1	Field Instrumentation & Networks
2	Process Modeling & Simulation	2	Process Modeling & Simulation
3	Project Planning Estimation & Assessment	3	Project Planning Estimation & Assessment
4	Elective II	5	Elective II
5	Project Work & viva voce	5	Project Work Phase II & viva voce