SHIVAJI UNIVERSITY, KOLHAPUR

Structure for Instrumentation Engineering Degree Course
Introduced from July 2016
B.E. (Instrumentation Engineering)

## Semester - VII

| Sr. No. | Name of Subject | Teaching scheme(Hrs) | | | | Examination Scheme(Marks) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| -- | -- | L | T | P | Total | Theory | TW | POE | Oral | Total |
| 1 | Virtual Instrumentation | 3 | - | 2 | 5 | 100 | 25 | - | 25 | 150 |
| 2 | Process Modeling & Simulation | 4 | - | 2 | 6 | 100 | 50 | - | 25 | 175 |
| 3 | Digital Signal Processing | 4 | - | 2 | 6 | 100 | 25 | - | - | 125 |
| 4 | Elective –I | 4 | - | - | 4 | 100 | - | - | - | 100 |
| 5 | Process Equipment Design | 4 | - | 2 | 6 | 100 | 25 | - | 25 | 150 |
| 6 | Project Design Phase-I | - | - | 2 | 2 | - | 50 | | - | 50 |
| 7 | Industrial Training* | - | - | 2 | 2 | - | 50 | - | - | 50 |
| | Total | **[19]** | - | **[12]** | **[31]** | 500 | 225 | - | 75 | 800 |

***Term-work Industrial Training will be based on Industrial Training and report

**Elective - I:**

1]Building Automation, 2]Neural &Fuzzy Control, 3] Instrumentation for Agricultural,
4] Automobile Instrumentation

## Semester - VIII

| Sr. No. | Name of Subject | Teaching scheme(Hrs) | | | | Examination Scheme(Marks) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| -- | -- | L | T | P | Total | Theory | TW | POE | Oral | Total |
| 1 | Field Instrumentation | 4 | - | 2 | 6 | 100 | 50 | - | 25 | 175 |
| 2 | Advanced Process Control | 4 | - | 2 | 6 | 100 | 50 | - | 25 | 175 |
| 3 | Elective- II | 4 | - | - | 4 | 100 | - | - | - | 100 |
| 4 | Project Engineering & Management | 4 | - | 2 | 6 | 100 | 50 | - | - | 150 |
| 5 | Project Phase –II | | - | 4 | 4 | - | 100 | - | 100 | 200 |
| | Total | **[16]** | - | **[10]** | **[26]** | 400 | 250 | - | 150 | 800 |

**Elective - II:**

1] Optical Instrumentation, 2] Advanced Digital Signal Processing, 3] Environmental Instrumentation,
4] Robotics &Automation

# B.E. INSTRUMENTATION –PART I
## VIRTUAL INSTRUMENTATION

Teaching Scheme:
Lectures: 3Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 25 Marks
OE : 25 Marks

**Course Education Objectives (CEOs)**

Upon completion of this course, student should be able to:

1.Understand basics of virtual instrumentation

2.Know data acquisition systems

3.Develop application of process control

**Course Outcomes (COs):**

1.Student will able to explain basics of virtual instrumentation.

2.Students will able to do programming.

3.Student will able to know data acquisition.

4.Students will able to do analysis of Fourier transforms correlation methods, windowing & filtering.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | 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. | 06 |
| 2 | Programming Techniques : VIS & Sub VIS, loops & charts, arrays, clusters, graphs, case & sequence structures, formula modes, local and global variable, string & file input. | 05 |
| 3 | Data Acquisition basics : ADC, DAC, DIO, Counters & timers, PC Hardware structure, timing, interrupts, DMA, Software and Hardware Installation. | 04 |
| 4 | 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 | 06 |
| 5 | Use of Analysis Tools : Fourier transforms, Power spectrum, Correlation methods, windowing & flittering. | 05 |
| 6 | Application in process control:<br>Flow, Pressure, Temperature, Level control case study. Condition monitoring of pumps, data acquisition. | 06 |

**Recommended 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, secondEdition, Instrument Society of America, 1994.
5. Technical manuals for DAS modules of national instruments
L .T.amy Automation system for control & data acquisition.

**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART I
## PROCESS MODELING & SIMULATION

Teaching Scheme:
Lectures: 4 Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 50 Marks
OE : 25 Marks

**Course Education Objectives (CEOs)**
Upon completion of this course, student should be able to:
1.Find models of physical and chemical processes.
2.Understand the concepts of constrained and unconstrained optimization.

**Course Outcomes (COs):**
1.Students will able to explain dynamics of process.
2.Student will able to formulate model of certain system.
3.Student will able to identify unknown parameters of process.
4.Students will able to know optimization techniques.
5.Students will able to describe basic simulation.

### Course Syllabus

| Unit | | Hours |
|---|---|---|
| 1 | **Introduction:** Dynamicsand stability of controlled systems. Dynamic behavior of process linear, non linear, first and second order system. The development of mathematical model to describe process dynamic behavior. | 03 |
| 2 | **Modeling of Mechanical & Chemical systems :**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, Input-output model and its transfer function, Modeling of series and parallel tank system, Dynamic modeling of tank reactor system. Vaporizer flashes drum, batch reactor, Binary distillation column, boiler. | 14 |
| 3 | **Numerical 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 | 04 |
| 4 | **Process Identification:** Purpose**,** Parametric and non parametric methods of process identification (Time domain Eyeball fitting of step test data, sine, pulse and step signal testing, ATV Identification). Theoretical and Empirical model identification. | 05 |
| 5 | **Intelligent controllers:** Expert systems and expert controller, ANN controller, Adaptive control system (Self tuning regulator & Model reference adaptive controller), Inferential control systems, modelpredictive controller. | 04 |
| 6 | **Optimization:** Optimization techniques and application, Single and multivariable optimization, line programming , Sequential quadratic programming & reduced | 05 |

| | | |
|---|---|---|
| | gradient optimization technique & application, Introduction to geometric programming and dynamic programming. | |
| 7 | **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. | 06 |

**Recommended Books:** -


1. Process control: Thomas E. Marlin, Mc Graw Hill Publication.
2. Chemical process control: Geoyestephanppolous, 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 – GeofferyGorden
8. System simulation with digital computer – NarsingDeo
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


**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART I
## DIGITAL SIGNAL PROCESSING

Teaching Scheme:
Lectures: 4Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 25 Marks

**Course Education Objectives (CEOs)**

Upon completion of this course, student should be able to:
1.Know fundamentals of system
2.understand fundamentals of fourier and Z transform
3.Understand fundamentals of digital filter design.
4.Know the applications of DSP

**Course Outcomes (COs):**

1.define CT signals mathematically & solve problems related to operations on signals
2.To apply different tools like Z-transform, Fourier Transform to analyze the systems.
3. Student will able to design digital FIR & IIR filters.
4. Students will able to know applications of DSP.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Introduction to Signals and Systems:** Definition of signal in continuous time (CT) and discrete time (DT), representation of signals in DT,Classification of signals (CT/DT), Basic Signals (CT/DT), basic operations on signals (CT/DT) -time scaling,time-shifting, time-reversing, amplitude scaling, additions, subtractions, multiplications, derivative/difference, integral/sum. Definitions of systems, classification of systems based on properties-Linearity, Causality, Stability, Memory, Invariance, and inevitability.Convolution sum-impulse response, properties of convolution. Correlation-Auto-correlation,Crosscorrelation | 08 |
| 2 | Sampling theorem, Z-transforms by summation of left, right, and two-sided sequences, Region of Convergence and Z-transform properties, pole-zero plot, Inverse Z-transform by partial-fraction, power-series, and contour integration expansion, Solution of linear constant coefficient difference equation (LCCDE) using Z-transform. Frequency response characteristics: frequency response of Linear Time-invariant (LTI) systems, magnitude and phase response of LTI systems, ideal frequency selective filters, phase delay, group delay | 08 |
| 3 | **Fourier analysis in DT domain** Definition of discrete-time Fourier series (DTFS), Computation of DTFS, Properties of DTFS, Computation of Inverse DTFS.Definition of discrete-time Fourier transform (DTFT), Computation of DTFT, Properties of DTFT,Computation of IDTFT.Definition of Discrete Fourier transform (DFT), Computation of DFT, Properties of DFT, Circular convolution, Computation of IDFT.Fast Fourier Transform: Radix-2 Decimation in time (DIT) FFT algorithm, | 08 |

| | | |
|---|---|---|
| | Radix-2 Decimation in frequency (DIF) algorithm, impulse computations, bit-reversal, IFFT using DIT and DIF algorithms. | |
| 4 | **Finite Impulse Response (FIR) Digital Filters**<br>Symmetric and Antisymmetric FIR filters, Liner phase filters, Design of FIR filters using Hamming,Rectangular, Hanning, Blackmann, and windows, Design of FIR filters using frequency samplingmethod, Realization of FIR filters using transversal, linear phase and polyphase structures. | 06 |
| 5 | **Infinite Impulse Response (IIR) Digital Filters**<br>Review of design of analogue Butterworth and Chebyshev Filters, Design of IIR filters using impulse invariance technique, Design of IIR filters using Bilinear transformation, Realization of IIR filters using Direct form-I, Direct form-II, Cascade and Parallel Forms. | 06 |
| 6 | **DSP Applications:**<br>Adaptive Telephone echo cancellation, fetal ECG monitoring, evoked potential Analysis, speech synthesis and reorganization. Application related to instrumentation and biomedical signal processing. | 03 |

## Recommended books:

**Text Books:**

1. A. V. Oppenheim and R. W. Schafer, “Discrete Time Signal Processing”, Pearson Education.
2. J. G. Proakis and D. J. Manolakis, “Digital Signal Processing: Principles, Algorithms and Applications”, PHI, 2000.

**Reference Books:**

1. B. Porat, “A Course in Digital Signal Processing”, J. Wiley and Sons.
2. J. R. Johnson, “Introduction to Digital Signal Processing”, PHI.
3. Rabiner, Gold, “Theory and Applications of Digital Signal Processing”, TMH.
**4.** S. K. Mitra, “Digital Signal Processing-A Computer Based Approach”, MGH
**5.** E. C. Ifeachor and B. W. Jervis, “Digital Signal Processing-A practical Approach”, Addison-Wesley publication

**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART I
## PROCESS EQUIPMENT DESIGN

Teaching Scheme:
Lectures: 4 Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 25 Marks
OE : 25 Marks

**Course Education Objectives (CEOs)**
Upon completion of this course, student should be able to:
1.Understand the concept of instrumentation system.
2.Be able to analyze and design aspects of various process
3.Know PCB design techniques

**Course Outcomes:**
1.Students will able to various standards for calibration & testing.
2.Students will able to design considerations of process as well as trouble shooting & maintenance.
3.Students will able to know PCB technology.
4.Students will able to design PID controller & signal conditioning.

## Course Syllabus

| Unit | | Hrs |
|---|---|---|
| 1 | **Industrial Standards:** NEMA, DIN, BIS and ANSI standards with special reference to packaging, one line diagram of hydraulic, pneumatic and electronic instrumentations system, Instruments symbols and signals. | 04 |
| 2 | **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. Transducer measurement and performance test (electrical, impedance, 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 | 08 |
| 3 | **Distributed Control Systems components:** 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. | 06 |
| 4 | **Vendor Architectures & Applications:** 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. | 08 |
| 5 | **State of the art in DCS:** Integration of DCS, PLC, HMI & SCADA systems. Integration with RTUs, Multiplexers, field buses& Data Highways. Hybrid systems with discrete & analog capability. Sequence of Event recorders & post-trip reviews. | 07 |

OPC software architecture.

| | | |
|---|---|---|
| 6 | **Design Of Electronic Controllers:** Selection of sensor, signal conditioning. ON-OFF and Integral, Derivative, Proportional controllers for flow, level, pressure & temperature systems. | 07 |

**Recommended Books: -**

1) Electronic Instruments And instrumentation Technology, by Anand M S, New Delhi.Prentice Hall Of India, 2004.
2) Process Control, by B.G.Liptak
3) Industrial Process Control by Jocob
4) Process Control for Industries by Andrew Williams.
5)Distributed computer control for Industrial Automation: Popovic&Bhatkar, Dekker.
6) Understanding Distributed processor systems for control - smuel Herb, ISA.
**7)**Process software and Digital Networks. Bela Liptak, CRC Press.

**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART I

## PROJECT WORK PHASE- I & SEMINAR

Teaching Scheme: Examination Scheme:-
Practical: 02 Hrs/Week TW : 50 Marks

**Course Education Objectives (CEOs)**

Upon completion of this course, student should be able to:
1.Understand his/her topic of interest.
2.Understand the work has been carried out in his topic.
3.Develop his/her oral communication and presentation skills.

**Course Outcomes (COs):**

1.Student will know latest techniques in instrumentation engineering.
2.Student will able to explain technology in detail.
3.Students' technical knowledge would be developed.
4.Student will able to organize the talk.
5.Student will able to develop presentation skills.

## Course Syllabus

| Unit | | Hrs |
|---|---|---|
| | 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.<br>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. | 02 |

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# B.E. INSTRUMENTATION –PART I
## INDUSTRIAL TRAINING

Teaching Scheme: Examination Scheme:-
Practical: 02 Hrs/Week TW : 50 Marks

**Course Education Objectives (CEOs)**
Upon completion of this course, student should be able to:
1.Experience and understand real life situations in industrial organizations and their related environments and accelerating the learning process.
2.Understand the real career world and accustoms them to an organizational structure, business operation and administrative functions.
3.To applying their technical skills as well as developing their personal and communications skills.
**Course Outcomes (COs):**
1.Student will able to adapt readily to real life working environment and practice the right work attitude.
2.Student will able to apply knowledge learnt, gain new skills and be aware of current technologies.
3.Student will able to provide opportunities for organization to assess them as prospective employees
4.Student will able to explain industrial problems and suggest possible solutions.
5.Student will able to present a proper report, both orally and in writing on their work experience.

## Course Syllabus

| Unit | SECTION –I | Hrs |
|---|---|---|
| | It consist of assessing the Industrial Training (and training report) under taken by the students at the end of 6th 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 ofresearch work & on becoming entrepreneurs. | 2 |

# B.E. INSTRUMENTATION –PART I

## ELECTIVE – I (BUILDING AUTOMATION)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:
1.Understand basics alarm system
2.Know security system
3.Understand HVAC

**Course Outcomes (COs):**Students should be able to
1.Describe alarm system
2.know security system
3.Identify processes in HVAC
4. Explain Energy management systems

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | Alarm Systems:<br>What is fire, fire modes,<br>FAS components: Field components, panel components, applications<br>FAS architecture: Types and examples.<br>FAS loops : Classification of loops<br>Power supply design for FAS,<br>Fire standards: FAS design procedure in brief, NFPA 72A, BS 5839, IS | 08 |
| 2 | Security System:<br>Introduction of security system, concepts, Access control components, Access control system design. | 06 |
| 3 | Introduction:<br>HVAC fundamentals, properties of air, psychometric chart, heat transfer mechanisms, Human comfort zones, effect of heat humidity and heat loss. | 06 |
| 4 | Processes:<br>Heating process and applications (ie. Boiler & Heater), cooling process and applications (ie. Chiller), ventilation process & application (ie. Central fan systems, AHU, Exhaust fans), Unitary systems. | 08 |
| 5 | Control Panel : HVAC control panel, MCC Basics, Panel components<br>Energy Management: Advantages of BMS, energy saving concepts & methods, lightning control, Lightening control, Building efficiency improvement, Green building concepts. | 06 |

| | | |
|---|---|---|
| 6 | Project Life cycle: IBMS (HVAC, fire & security), project cycle, project steps BMS, Applications of BMS, IBMS architecture, Normal & emergency operation | 06 |

**Recommended books:**

1.Design of special hazards and fire alarm systems by Robert Gagonon (20070
2. Integrated security system design: Concepts , specification & implementation by Thomos L Norman,
3.HVAC control and systems by Levenhagen, John I. Spethmann, Fonald H.
4.Building control system application and guide by CIBSE (2000)

# B.E. INSTRUMENTATION –PART I

## ELECTIVE – I (NEURAL & FUZZY CONTROL)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:

1.Develop in students the skills to gain a basic understanding of neural network theory and fuzzy logic theory.

2.Explore the functional components of neural network classifiers or controllers, and the functional components of fuzzy logic classifiers or controllers.

3.Develop and implement a basic trainable neural network or a fuzzy logic system for a typical control, instrumentation application.

**Course Outcomes (COs):**

1.Student will able to Explain artificial neural systems.
2.Students will able to develop neural control systems.
3.Student will able to know fuzzy logic controller.
4.Student will able to develop control system using neural & fuzzy logic.

## Course Syllabus

**Unit 1:-Fundamental Concepts and Models of Artificial Neural Systems [7Hrs]**

Biological Neurons and their Artificial Models- Biological neurons, Mc-Culloch-Pitts Neuron Model, Neuron Modeling for Artificial Neural Systems, Models of artificial neural networks- Feedforward Network, Feedback Network, Supervised and Unsupervised Learning, Neural Network learning rules- Hebbian Learning Rule, Perceptron Learning Rule, Delta Learning Rule, Widrow-Hoff Learning Rule, Correlation Learning Rule, Winner-Take-All Learning Rule, Outstar Learning Rule.

**Unit 2:-Single Layer and Multilayer Feedforward Networks [7Hrs]**

Single layer networks-Perceptrons, Linear separability,Training and classification using the discrete perceptron algorithm.

Multi Layer Feedforward networks: -Linearly non separable pattern classification, Delta learning rule for multi perceptron layer, Generalized delta learning rule, Feedforward recall and error back propagation training, Learning factors.

**Unit 3: Single Layer Feedback Networks [5Hrs]**

Basic concept of dynamical systems, Mathematical foundation of discrete time Hopfield networks, Unsupervised learning of clusters, Feature mapping, self organizing feature maps.

**Applications of Neural Networks:** Control Applications, Overview of Control Systems Concepts, Process Identification.

**Unit 4: Introduction to Fuzzy Logic [4Hrs]**

Basic concepts of fuzzy sets- Relation equation- fuzzy logic control- fuzzification- defuzzification- knowledge base- Decision making logic- membership function- rule base.

**Unit 5: Fuzzy Logic Control [8Hrs]**

Fuzzy Logic Controller: Functional diagram, Membership Functions: Triangular, Trapezoidal etc. Fuzzyfication: Membership value, Knowledge base, Defuzzyfication: Max membership principle- centroid method, Weighted average method etc. Choice of variables- derivation of rules.

**Unit 6: Application of Fuzzy Control Systems [5Hrs]**

Functions of the different modules in a FKBC, Design of P, PI, PD, PID controllers, Design of fuzzy logic controller, Fuzzy controllers, Adaptive fuzzy controllers, Stability of fuzzy control systems.

**Reference Books**:

1. “Introduction to Artificial Neural Systems”, by Jacek M. Zurada

2. “Element of Artificial Neural Networks”, by KishanMehrotra, Chilukuri K. Mohan, Sanjay Ranka, 2nd edition, 2010.

3. “Artificial Neural Networks”, by B. Yegnanarayana.

4. “An Introduction to Fuzzy Control”, D. DRIANKOV, H. HELLENDOORN and M. REINFRANK Narosa Publication House, 2nd reprint 1997.

5. “Neuro-fuzzy and Soft Computing”, PHI publication.

6. “Fuzzy logic: Intelligence control and Information”, John Yen Pearson publication.

# B.E. INSTRUMENTATION –PART I

## ELECTIVE – I (INSTRUMENTATION FOR AGRICULTURAL)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:
1.Understand sensors used in agriculture field
2.Know continuous and batch process
3.Know green house automation schemes

**Course Outcomes (COs):**
Upon completion of this course, student should be able to
1.Explain soil properties and sensors used to measure
2.Demonstrate continuous and batch process
3.Develope automation scheme for green house

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Necessity of instrumentation and control for agriculture sensor requirement, remote sensing, biosensors in agriculture, standards for food quality | 04 |
| 2 | **Soil Properties & Sensing :** Properties of soil: fundamental definitions & relationships, index properties of soil,permeability & seepage analysis, shear strength, Mohr's circle of stress, active & passiveearth pressures, stability & slopes, Sensors: introduction to sonic anemometers,hygrometers, fine wire thermocouples, open & close path gas analyzers | 06 |
| 3 | **Instrumentation in Continuous & Batch process:** Flow diagram of sugar plant, sensors & instrumentation set up, Flow diagram of fermenter & control (batch process), flow diagram of dairy industry & instrumentation set up for it, juice extraction control process & instrumentation set up. | 05 |
| 4 | **Instrumentation in Irrigation:** Water distribution & management control, Auto drip & sprinkler irrigation systems, irrigation canal management systems, upstream & downstream control concept, SCADA for DAM parameters & control. | 05 |
| 5 | **Greenhouse Parameters & Instrumentation:** Greenhouse effect, Concept & construction of green houses, merits & demerits, ventilation, cooling & heating, wind speed, temperature & humidity, soil moisture, rain gauge, carbon dioxide enrichment measurement & control, Leaf area length evapo-transpiration, temperature, wetness & respiration measurement & data logging, electromagnetic radiations photosynthesis. | 08 |
| 6 | **Applications in agricultural and food products:** Automation in earth moving equipments& farm equipments, application of SCADA & PLC in packing industry and cold storage systems, implementation of hydraulic, pneumatic & electronics control circuits in harvesters cotton pickers, tractor etc. classification | 08 |

of pumps: pump characteristics, pump selection & installation.

**Recommended books:**


1. Industrial instrumentation, “Patranabis”, TMH.
2. Instrumentation handbook-process control, “B.G.Liptak”, Chilton.
3. Process control and instrumentation technology, “C.D. Johnson”, PHI
4. Wills B.A., “ Mineral Processing Technology”, 4th Ed.,Pergamon Press
5. Principle of Farm Machinery, R.A Kepner, Roy Bainer;: CBS Publication
6. Agricultural Engineering; RadheyLal: Saroj Publication
7. Environmental Engineering, Peary. II. S. and others

# B.E. INSTRUMENTATION –PART I

## ELECTIVE – I (AUTOMOBILE INSTRUMENTATION)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**

**:** Upon completion of this course, student should be able to:

1.Know the fundamentals of automotive electronics

2.Understand automotive control systems

3.know basics of safety factors in automobile.

**Course Outcomes (COs):**

1. Ability to understand electronic control unit.
2. Acquire knowledge of various automotive standards and Protocols.
3.Design aspects of measurement and control strategies in automotive application.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Fundamentals of Automotive Electronics:** Open loop and closed loop systems components for electronic engine management, vehicle motion control, Current trends in modern Automobiles | 08 |
| 2 | **Electronic Fuel Injection and ignition systems:** Introduction, throttle body ignition and multi port or point fuel injection, Advantages of electronic ignition system, Types of solid state ignition systems and their principle of operation, electronic spark timing control system, | 08 |
| 3 | **Engine control system:** Engine cranking and warm up control, Acceleration enrichment –Deacceleration leaning and idle speed control, integrated engine control system, exhaust emission control system, Engine performance testing | 06 |
| 4 | **Automobile chassis electronic control system:** Principle of electronic braking, automatic transmission electronic control circuit, cruise control circuit, the electronic steering control theory, ABS, ASR, ESP, and other electronic control method | 08 |
| 5 | **Auto Body Electronic Control Technology:** Automotive central locking and anti-theft system control technology, electronically controlled windows and doors and airbag technology, principle of control circuit components and characteristics. | 06 |
| 6 | **Ergonomics and safety:** Driver information system, lighting system components, battery monitoring and control, Air conditioning, steering control techniques, Automatic gear control systems, Emission standards. | 06 |

**Recommended books:**

1. William B. Riddens, “Understanding Automotive Electronics”, 5th Edition, (Butterworth Heinemann Woburn), (1998).
2. Tom Weather Jr and Cland C. Hunter, “Automotive Computers and Control System”,Prentice Hall Inc. ,New Jeresy.

**Reference books:**

1. Jiri Marek, Hans Peter trah, “Sensers Applications, Sensers for Automotive Technology” 1st Edition , Wiley
2. T. Mellard, Automotive Electronic Systems”1987 by Heinenmann Professional

# B.E. INSTRUMENTATION –PART II
## FIELD INSTRUMENTATION

Teaching Scheme:
Lectures: 4Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 50 Marks
OE : 25 Marks

**Course Education Objectives (CEOs)**

Upon completion of this course, student should be able to:

1.To analyze, specify, and debug industrial data communication systems,
2. Industrial protocol, industrial networks in the instrumentation and control environment.

**Course Outcomes (COs):**

1.Student will able to explain components of digital field bus networks.
2. Student will able to describe working of Foundation Fieldbus & HART protocols.
3. Student will able to outlineprofibus networks
4. Student will able to explain fiber optic networks.
5. Student will able to specify use of wireless networks.

**Course Syllabus**

| Unit | | Hours |
|---|---|---|
| 1 | **Introduction to Networks & Fieldbus:** Proprietary & open networks. Hardware selection for Fieldbus systems .Sorting the protocols. Fieldbus trends, Advantages & Disadvantages, Design, installation, economics & documentation. | 08 |
| 2 | **Hart Networks:** Hart protocol, field Devices, calibration, Hart applications, installing Hart Networks, Device Descriptions and Applications. Wireless transmitters & their architecture, Wireless Hart. | 08 |
| 3 | **Foundation Fieldbus Networks**: Standards, field bus Architecture and user Layer, H1 & HSE specifications, Segment design. | 07 |
| 4 | **Profibus Networks:** Basics, Block Model, Applications, Network Design, system configuration and Developments. Profibus PA & DP specifications. Segment design. | 05 |
| 5 | **Fiber-Optic Networks**: Principles, Types of Cables, Network Design, installation finishing, inspection and Testing. Modulation/Demodulation techniques. | 05 |
| 6 | **Network Installation & Security:**Network components, Configuring routers & switches.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. | 07 |

**Recommended Books: -**

1.Instrument Engineers Handbook ‘Process software and Digital Networks’: Bela Liptak, CRC process.
2.Practical industrial data networks ‘Design, installation & trouble shooting, by Steve Mackay, Edvin Wright, Deol and John Park, Elsevier Publication.
3.Understanding Distributed Process system for control samnel Herb, ISA.
4. Introduction to Networking Richard McMahon, TMH.
5. Networking A beginner’s Guide: Bruce Hallberg, TMH.

**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART II
## ADVANCED PROCESS CONTROL

Teaching Scheme:
Lectures: 4 Hrs/Week
Practical: 02 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks
TW : 50 Marks
OE : 25 Marks

**Course Education Objectives (CEOs)**
Upon completion of this course, student should be able to:
1.Understand various processes
2.Develop Instrumentation schemes for processes
3.Apply the control strategies for various process applications.
4.Know about Building automation.

**Course Outcomes (COs):**
1.Students will able to know control strategies.
2.Student will able to design PID controller algorithms.
3.Students will able to know digital control methods.
4.Student will able to explain HVAC & access control.

## Course Syllabus

| Unit | | Hrs |
|---|---|---|
| 1 | **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. | 04 |
| 2 | **Instrumentation schemes:** operation, controlled and manipulated variables, feedback, feed forward, cascade control strategies for heat exchanger, dryers and crystallizers. | 06 |
| 3 | **Distillation Column Control:** Operation of distillation column, Feed forward Systems, Flow Control of Distillate and Bottoms, Reflux control, Composition Control, Pressure and Temperature Controls. Constant and maximum recovery methods, distillate optimization. Multiproduct control, distillation control using neural control. | 06 |
| 4 | **Digital control methods**: Direct Digital Control, Supervisory computer control, Interactive multivariable control system, Alarm & alarm management system<br>Case Studies: Design of DC motor control, vibration analysis, pH control, agricultural control. (System specifications, Block diagram, system design, Schematic diagram). | 08 |
| 5 | **Boiler Instrumentation :**<br>Operation of boiler, manipulated and controlled variables in boiler control. Safety interlocks and burner management system, instrumentation for boiler pressure control, air to fuel ratio control, boiler drum level control, steam temperature control, optimization of boiler efficiency. | 06 |
| 6 | **Instrumentation for Pumps and Compressors:**<br>Types and operation of pumps, manipulated and controlled variables in pump control, | 06 |

pump control methods and instrumentation for pump control, types and operation of compressors, capacity control method of compressors, instrumentation for control of different variables in centrifugal, rotary and reciprocating compressor including surge and anti surge control.

| | | |
|---|---|---|
| 7 | **Process Safety & Safety management Systems:**<br>Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis (PHA), Hazard and operability study ( HaZOp), Safety Integrity Level (SIL), Introduction to IEC61511 standard for Functional safety , protection layers, Safety Instrumented System: function, architecture, safety life cycle, Application of safety system | 06 |

**Recommended 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 – RamakantGaikwad
(10) Distributed computer control for industrial automation, PpovikBhatkar, Dekkar Pub.

**Term Work:**

It shall consist of at least 8 relevant experiments from the topics in the syllabus.

# B.E. INSTRUMENTATION –PART II
## PROJECT ENGINEERING & MANAGEMENT

| | |
|---|---|
| Teaching Scheme: | Examination Scheme:- |
| Lectures: 4 Hrs/Week | Theory Paper: 100 Marks |
| Practical: 02 Hrs/Week | TW : 50 Marks |

**Course Education Objectives (CEOs)**

Upon completion of this course, student should be able to:

To impart and train the perspective engineers who would like to join the EPC contracting or designing or project enterprises organizations in respect of instrumentation engineering.

**Course Outcomes (COs):**

1.Student will able to know detailed engineering.
2. Students will know P & I diagrams and standards for instrumentation identification.
3. Student will able to develop engineering documentation.
4.Students will able to identify different types of cables and project monitoring techniques.
5. Student will able to illustrate installation and commissioning activities.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Introduction to Project Engineering**: Definition of Project, Characteristics, Project objectives & scope, Project Management functions, Management Cycle, Project Life cycle, Activity v/s documents, quality and organization structure. | 04 |
| 2 | **Project Scheduling & Basic Engineering**: Statement of Work/ Project Statement, Project Scheduling Techniques, Costs & Estimations, Degree of automation, manpower consideration, interdepartmental and inter-organization interactions, Multi Agency Interactions. | 04 |
| 3 | **Detailed Engineering and Documentation**: Document Control, Instrument Selection, Material of Construction, Area Classification, Instrument Specification, Drawings, Control Centre Design, Standards used in Project, Process flow Diagrams, P and I diagrams, Process Data sheet, Material Balance Sheet, Instrument Index Sheet, Specification sheets, ANSI/ISA standards for instrument identification. | 04 |
| 4 | **Procurement & Installation**: Tenders, Steps in Purchasing, Purchase Order, Vendor Documents & Drawings, Site Selection & Plant layout drawing, Contracting, Bid Analysis, Bill of Material, Installation sketches, loop schematics and termination diagrams, hook up diagrams, wiring diagrams, interlock diagrams, isometrics, Start-Up, Calibration, Installation Contract | 08 |
| 5 | **Cable Engineering**: Types of cables, Cable Support, Cable Installation Considerations, tubing, glanding and termination, need for junction boxes, laying cable and tubing. | 03 |
| 6 | **Installation Details for System**: Pressure instruments, temperature instruments, flow Instruments, d. p. transmitter, pH electrode, control valve, Final Control Elements etc..<br>Equipment level automation and role of hydraulics, pneumatic electronic devices and systems. Power/air distribution system. | 04 |

| | | |
|---|---|---|
| 7 | **Commisioning& Monitoring**: Loop & Hardware Check, Systems Check, Punch List, correction Verification, Instrument Grounding, Comissioning Stage (Hot & cold), Acceptance Testing, Factory Acceptance Testing, Customer Acceptance Test, Site Acceptance Test, Loop Tuning, Maintenance Training, Production Training<br>**Project monitoring**: project bar chart, network diagram, fixing critical path, project evaluation and review techniques\ | 06 |
| 8 | **Control Centers & Panels:** Control Room Layouts, Control Room Engineering, Engineering Aspects & Design Criteria, Control Panel types, Panel Layout, Panel Wiring, Graphic Displays, Panel Bid Specifications, Panel Inspection & Testing | 04 |

**Recommended 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. Johnson.
5. Process control Instrumentation Technology - C.D. Johnson (4th Ed)
6. Programmable Logic controller - J.D.Otter (PHI).
7. Industrial Programmable Controller (ISA)
8. Applied Instrumentation in Process Industries Vol. I & II – Andrews Williams
9. Project Management System Approach to Planning, Scheduling & Controlling, Van Nostrand Reinhold Publishing – HardlodKrenzer


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

# B.E. INSTRUMENTATION –PART II

## PROJECT PHASE - II

Teaching Scheme:
Practical: 04Hrs/Week

Examination Scheme:-
TW : 100 Marks
OE: 100 Marks

**Course Education Objectives(CEOs)**

1.Understand his/her topic of interest.
2. Understand the work has been carried out in his topic.
3. Design and develop various instrumentation schemes required for topic.
4. Improve technical and communication skill.

**Course Outcomes (COs):**

Upon successful completion of this course, the student will be able to:
1.Students will able to apply knowledge learnt, gain new skills and be aware of current technologies
2. Student will able to design instrumentation systems.
3. Student will able to improve technical and communication skill.
4. Student will able to suggest possible solutions to industrial problems.
5. Student will able to present a proper report, both orally and in writing on their work experience.

**Course Syllabus**

| Unit | | Hours |
|---|---|---|
| | 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. | |

# B.E. INSTRUMENTATION –PART II

## ELECTIVE – II (OPTICAL INSTRUMENTATION)

Teaching Scheme: Examination Scheme:-
Lectures: 4 Hrs/Week Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:
1.Understand optical fundamentals
2.Know fiber optic sensors and applications
3.Know laser gyroscopes
**Course Outcomes (COs):** Upon completion of this course, student should be able to
1.Explain Optoelectronics & display devices.
2.Select various fiber optic sensors for applications
3.Describe laser gyroscopes

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Optoelectronic Fundamentals**<br>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. | 06 |
| 2 | **Display Devices**<br>minescence 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. 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. | 08 |
| 3 | **Optical Fibers**<br>Classification of optical fiber, principle of light transmission through a fiber, fabrication of optical fibers, material consideration loss and band width limiting mechanism, perform fabrication techniques, fiber drawing, fiber optic communication system. | 08 |
| 4 | **Optical Fiber Sensors**<br>Fiber optic sensors, intensity modulated sensors, microbend strain intensity modulated sensor, liquid level types hybrid sensor, internal effect intensity modulated sensor, phase sensor, diffraction grating sensors, sensors using single mode fiber, interferometric temperature sensor, distributed fiber optic sensors, polarization problem in interferometric sensors using single mode fiber. Medical applications of fiber sensors, Fabry-Perot fiber optic sensors, Electric field and voltage sensors, Chemical fiber optic gyroscopes, magnetic field and current fiber sensor, military and aerospace applications, important applications of integrated optic fiber technology, Local area networks. | 07 |

| | | |
|---|---|---|
| 5 | **Optical Fiber Sensor Applications**<br>Special applications, ADM, video link, satellite link, computer link, nuclear reactor link, digital transmission in optical fiber networks, video compression, N.A. measurement, working of OTDR, microprocessor based OTDR, applications of OTDR, dispersion measurements, Bit Error Rate (BER) measurement, attenuation measurement using OTDR, cutoff wavelength measurement, microbending loss. | 07 |
| 6 | **Laser Gyroscopes and Holography**<br>The Sagnac effect, Basic gyro configurations. Ring Laser Gyros (RLG): Dithered RLG, Ring Zeeman laser gyro, performance of RLG. Fiber Optics Gyros (FOG): Open loop FOG, Requirements on FOG components, technology to implement FOG, Closed loop FOG, the resonant FOG MEMS gyro, Piezoelectric gyro. The basic principles of Holography, viewing a hologram, volume hologram, multiplex hologram, white light reflection hologram. Measurement of strain, stress, bending moments and vibration by Holography, nondestructive testing, medical and dental research, solid mechanics. | 08 |

**Recommended 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
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
7. Chai Yeh, "*Handbook of fibre optic*s" (1990)
8. Ghatak A K and Thyagrajan, India, "*Laser theory and applications*", Macmillan (1988)
9. Sawhney A K, "*A course in Electrical and Electronics Measurement Instrumentation"*, Dhanpat Rai and Sons, New Delhi (1993)
10. Silvano D. "*Electro optical Instrumentation: Sensing and measuring with LASER*", PHI, New Delhi (2004).

# B.E. INSTRUMENTATION –PART II

## ELECTIVE – II (ADVANCED DIGITAL SIGNAL PROCESSING)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**

**:** Upon completion of this course, student should be able to:

1.Know adaptive signal processing.

2. Understand statistical signal processing

**Course Outcomes (COs):**

1.Students will able to explain adaptive signal processing.

2.Students will able to describe MultiMate signal processing.

3. Students will able to stastical signal processing.

4. Student will able to know DSP processors.

5. Students will able to do programming of TMC320C67XX.

**Course Syllabus**

| Unit | SECTION –I | Hours |
|---|---|---|
| 1 | **Adaptive Signal processing:** 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. | 08 |
| 2 | **Multirate Signal Processing:** 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. | 06 |
| 3 | **Statistical Digital Signal processing :** 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 | 06 |
| 4 | **Digital Signal Processor** :Hardware architecture, introduction to fixed point and floating point, DSP processors,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. | 14 |
| 5 | **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 | 06 |

**Recommended 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.,shohanA,LeeE.a.

# B.E. INSTRUMENTATION –PART II

## ELECTIVE – II (ENVIRONMENTAL INSTRUMENTATION)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:
1.able to understand methods of measurement of environmental parameters
2.know different types of pollution control techniques
3. understand instrumentation methods for environmental analysis.

**Course Outcomes (COs):**
1.Know different methods of measurement of
2.Identify different types of pollution control methods
3.Anlysis of instrumentation methods of environmental analysis.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | Environmental Definition, Constituents, biochemical cycle, causes of pollution, types of pollution and their measurements, effects of pollution, Different sensors for measurement of pollution.<br>**Introduction to environmental measurement** including temperature; flow rate; level and pressure, Emphasis on function, operation and maintenance of environmental devices. | 04 |
| 2 | Instrumentation Setup for different types of pollution control like wastewater treatment, HVAC Control etc. Environmental testing, Dry heat, Dry cold, Damp heat, Salt Spray, Dust, Altitude bump, Vibration Drop/Topple, free fall and study of ISO 14001. | 06 |
| 3 | Soil pollution and pesticide Analysis: Analysis of Micronutrients, trace elements pesticides, Chromatographic Characterization. Polar graphic and Spectroscope Analysis of pesticides.Noise Pollution and its Measurement: Units Devices and Maps Noise Control System.Radiation Pollution and its Measurement and Control. | 06 |
| 4 | **Instrumentation methods for Environmental analysis**: Theory and practice of modern instrumentation methods used in analysis of environmental samples; analysis of samples using UV – IR Spectrophotometer; Gas chromatography (GC); Liquid chromatography (LC) Ion chromatography (IC) and Atomic absorption spectrometer (AA) | 08 |
| 5 | **Air monitoring:** measurement of ambient air quality.<br>**Flow monitoring:** Air flow measurement, gas flow, non-open channel flow measurement,Open channel waste water flow measurement. Rain water harvesting: necessity, methods,Rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water. | 08 |

| | | |
|---|---|---|
| 6 | **Waste water monitoring:** Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants. | 08 |

**Recommended Books:**


1.Water treatment technology - Walter J. Weber
2.Air pollution engineering – M. N. Rao & H. V. N. Rao
3.Air pollution control technology – Wark& Warner
4.Environmental Instrumentation & Analysis Handbook- Randy D. Down.
5.Environmental Pollution Analysis by S. M. Khopkar 1st ed, Wiley Eastern 1993.
6.Basic Concepts of Analytical Chemistry by S. M. Khopkar.
7.Environmental Engineering by Peary H. S. and others.
8.Sensor Systems for Environmental Monitoring by Campbell.
9.Basic Environmental Technology-(Ed-1997) by J. A. Nathanson.
10.Environmental Tech. Series, V,I,II,III,IV by Neal K. Ustler.
11.Rao C S, “Environment Pollution control Engineering “ McGraw Hill

# B.E. INSTRUMENTATION –PART II

## ELECTIVE – II (ROBOTICS &AUTOMATION)

Teaching Scheme:
Lectures: 4 Hrs/Week

Examination Scheme:-
Theory Paper: 100 Marks

**Course Education Objectives (CEOs)**
**:** Upon completion of this course, student should be able to:
1.Know the fundamentals of robotics.
2.Select suitable component to develop robot for given applications.
3.use sensors and signal conditioning for given application

**Course Outcomes (COs):**
1.Describe fundamentals of robots
2.Identify suitable components for robot.
3. Design signal conditioning for robot.

**Course Syllabus**

| Unit | Contents | Hours |
|---|---|---|
| 1 | **Fundamentals of Robotics**<br>A.Robot definition and classification, brief history of robotics, types of robots, advantages and disadvantages of robots, robot components, Robot terminologies likeposition, orientation, degree of freedom, configuration, workspace (reach), kinematics, dynamics, accuracy, repeatability, path, trajectory, robot joints, robot coordinates ,robot reference frames, robot applications and social issues.<br>B. Robot sensors: sensor characteristics, position sensors, velocity sensors, acceleration sensors, force and pressure sensors. | 09 |
| 2 | **Robot Kinematics**:<br>A. Position Analysis: A. Robots as mechanisms, matrix representation, homogeneous transformation matrices, representation of transformations, inverse of transformation matrices, forward and inverse kinematics of robots, Denavit-Hartenberg representation of forward kinematic equations of robots, inverse kinematic solution of robots.<br>B.Inverse kinematic programming of robots | 09 |
| 3 | **Robot control fundamentals :** The Artificial intelligence viewpoint, comparison of human brain and computer in the contextof intelligent behavior, problem representation in A.I.system problem solving technique in A.I. | 08 |
| 4 | **Introduction to Automation:** Fully automatic systems, semi automatic systems and manual control systems,tele-operated systems, measurement system, control system, microprocessor based controller, introduction toPLC & DCS. | 06 |

| | | |
|---|---|---|
| 5 | **Sensors and signal conditioning:** introduction to transducers, various transducers used for the measurementof displacement, position, velocity, temperature, selection of sensor, signal conditioning, data presentation and data logging system | 08 |

**Recommended books:**

1.Lee C.S.G., Fu K. S., Gonzalez R.C. : “Robotic-Control, Sensing andIntelligence”, Mc-Graw Hill, Singapore, 1987.

2.Tsunco Yoshikawa, “Foundations of Robotics, Analysis and Control”, prentice Hall of India, 2001.

3.. Craig J J, “Introduction to Robotics: Mechanics and Control”, 2nd Edition, Boston, Addison – Wesley, 1989.

4.. Mittal R K and Nagrath I J, “Robotics and Control”, TMH Pub., New Delhi, 2003

5. An C H, Atkeson C G &Hollerbach J M, “Model based control of a Robot manipulator”, MIT Press, Mass.,1988

6.W. Bolton, “Mechatronics Electronic Control System in Mechanical and Electric Engineering”, Pearsoneducation Ltd. 2009

SHIVAJI UNIVERSITY, KOLHAPUR

Equivalence for Instrumentation Engineering Degree Course
Introduced from July 2016

**B.E. (Instrumentation Engineering)**

## Semester - VII

| Sr. No. | Name of Subject (New) | Equivalent Subject (Old) |
|---|---|---|
| 1 | Virtual Instrumentation | Virtual Instrumentation |
| 2 | Process Modeling & Simulation | Process Modeling & Simulation |
| 3 | Digital Signal Processing | Digital Signal Processing |
| 4 | Elective –I | |
| | Building Automation | - |
| | Neural & Fuzzy Control | Neural & Fuzzy based Control |
| | Instrumentation for Agricultural | - |
| | Automobile Instrumentation | - |
| 5 | Process Equipment Design | Instrumentation System Design<br>Industrial Automation-II |
| 6 | Project Design Phase-I | Project Work Phase-I & Seminar |
| 7 | Industrial Training* | Industrial Training |

## Semester – VIII

| Sr. No. | Name of Subject (New) | Equivalent Subject (Old) |
|---|---|---|
| 1 | Field Instrumentation | Field Instrumentation Network |
| 2 | Advanced Process Control | Advanced Process Control |
| 3 | Elective- II | |
| | Optical Instrumentation | Fiber Optics and Communication (T.E.) |
| | Advanced Digital Signal Processing | Advanced Digital Signal Processing |
| | Environmental Instrumentation | Safety & Environmental Control |
| | Robotics & Automation | - |
| 4 | Project Engineering & Management | Project Planning Estimation & Assessment |
| 5 | Project Phase -II | Project Work Phase II & viva voce |