

## SEMESTER VI

### THEORY:

S.No	Subject Name	L	P	M
1.	Industrial Instrumentation – II	4	0	100
2.	Process Control	4	0	100
3.	Power Electronics	4	0	100
4.	Engineering Management	4	0	100
5.	Analytical Instruments	4	0	100
6.	Elective I	4	0	100

### PRACTICALS:

S.No	Subject Name	L	P	M
1.	Industrial Instrumentation Laboratory	0	3	100
2.	Process Control Laboratory	0	3	100

## SEMESTER VI

### INDUSTRIAL INSTRUMENTATION – II

#### 1. MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE

9

Viscosity terms – say bolt viscometer – rotameter type viscometer – industrial consistency meters – humidity terms – dry and wet bulb psychrometers – hot wire electrode type hygrometer – dew cell – electrolysis type hygrometer – commercial type dew point meter – moisture terms – different methods of moisture measurement – moisture measurement in granular materials, solid penetrable materials like wood, web type material.

#### 2. MECHANICAL TYPE FLOWMETERS

8

Theory of fixed restriction variable head type flow meters – orifice plate – venturi tube – flow nozzle – dall tube – installation of head flow meters – piping arrangement for different fluids – pilot tube.

#### 3. QUANTITY METERS, AREA FLOW METERS AND MASS FLOW METERS

10

Positive displacement flow meters – constructional details and theory of operation of mutating disc, reciprocation piston, oval gear and helix type flow meters – inferential meter – turbine flow meter – rota meter – theory and installation – angular momentum mass flow meter – coriolis mass flow meters – thermal mass flow meter – volume flow meter plus density measurement – calibration of flow meters – dynamic weighing method.

#### 4. ELECTRICAL TYPE FLOW METER

9

Principle and constructional details of electromagnetic flow meter – different types of excitation – schemes used – different types of ultrasonic flow meters – laser doppler anemometer systems – rortex shedding flow meter – target flow meter – solid flow rate measurement – guidelines for selection of flow meter.

#### 5. LEVEL MEASUREMENT

9

Gauge glass technique coupled with photo electric readout system – float type level indication – different schemes – level switches level measurement using displacer and torque tube – bubbler system. Boiler drum level measurement – differential pressure method – hydra step systems – electrical types of level gauges using resistance, capacitance, nuclear radiation and ultrasonic sensors

**Total Hours**

**45**

## **TEXT BOOKS**

1. D.Patranabis, Principles of Industrial Instrumentation Tata McGraw Hill Publishing Co., New Delhi, 1999
2. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi 1999.

## **REFERENCES**

1. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Rai and Sons, New Delhi, 1999.
2. Patranabis, Principles of Industrial Instrumentation Tata McGraw-Hill Publishing Co., New Delhi, 1999
3. R.K.Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi 1999.

## **SEMESTER V I**

### **PROCESS CONTROL**

#### **1. INTRODUCTION**

**9**

Need for process control – mathematical model of first – order level, pressure and thermal processes – higher order process – interacting and non-interacting systems – continuous and batch process – self-regulation – servo and regulator operation.

#### **2.CONTROL ACTIONS AND CONTROLLERS**

**9**

Basic control actions – characteristics of on-off, proportional, single-speed floating, integral and derivative control modes – P+I, P+D and P+I+D control modes – pneumatic and electronic controllers to realize various control actions.

#### **3. OPTIMUM CONTROLLER SETTINGS**

**9**

Evaluation criteria – IAE, ISE, ITAE and  $\frac{1}{4}$  decay ratio – determination of optimum settings for mathematically described processes using time response and frequency response – tuning – process reaction curve method – Ziegler Nichols method – damped oscillation method.

#### **4. MULTILoop CONTROL**

**9**

Feed forward control – ratio control- cascade control – inferential control – split range control – introduction to multivariable control – examples from distillation column and boiler systems.

#### **5. FINAL CONTROL ELEMENT**

**9**

I/P converter – pneumatic and electric actuators – valve positioner – control valves – characteristics of control valves – inherent and installed characteristics – valve body – commercial valve bodies – control valve sizing – cavitation and flashing – selection criteria.

**Total Hours 45**

## **TEXT BOOKS**

1. Stephanopoulos, G, Chemical Process Control, Prentice Hall of India, New Delhi, 1990.
2. Eckman. D.P., Automatic Process Control, Wiley Eastern Ltd., New Delhi, 1993.

## **REFERENCES**

1. Pollard A.Process Control, Heinemann educational books, London, 1971.
2. Harriott. P., Process Control, Tata McGraw-Hill Publishing Co., New Delhi, 1991.

## **SEMESTER VI**

### **POWER ELECTRONICS**

**(Common to V-Sem EEE &VI-Sem EIE)**

#### **1. POWER SEMI-CONDUCTOR DEVICES**

**9**

Basic concepts of construction, ratings of SCR, diac, triac, Static V-I characteristics, gate Characteristics, ratings, protection of SCR, turn on and turn off methods, series and parallel Operation of SCRs, switching devices like power transistors, MOSFET, GTO, IGBT etc,Applications.

#### **2. PHASE CONTROLLED CONVERTERS**

**9**

Converter circuits: Single phase half wave, full wave, half controlled and fully controlled With resistive and inductive loads, use of feedback diode, three phase half wave & full wave Converters, Effect of source inductance, single-phase dual converter operation.

#### **3. DC TO DC CHOPPERS**

**9**

Principle of operation of chopper, types of choppers (single, two and four quadrant choppers), step up and step down chopper various commutation methods, voltage commutated chopper and current and load commutated Choppers

#### **4. INVERTERS**

**9**

Types of inverters, operation of 1-phase, 3 phase ( $120^\circ$   $180^\circ$ ) modes Series inverter, parallel inverter, voltage source inverters, current source

inverters, single phase centre tapped and bridge inverter with resistive load and inductive load. Use of feed back diode, three phase bridge inverters.

## **5 AC VOLTAGE CONTROLLERS, APPLICATIONS**

**9**

Single-phase AC voltage controller ,multi stage sequence control , step up and step down cycloconverters, three phase to single phase and three phase to three phase cycloconverters,SMPS ,UPS,Resonant Converters : ZVS,ZCS.

**Total Hours 45**

### **TEXT BOOKS**

1. Rashid, M.H., 'Power Electronics - Circuits Devices and Applications', Prentice Hall of India, 1995.
2. Singh.M.D and Kanchandani-'Power Electronics'-Tata McGraw-Hill & Hill publication Company Ltd New Delhi-2002.
3. Bhimbra. Dr.P.S., "Power Electronics" Khanna Publishers, 2001

### **REFERENCES**

1. Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised Power Controllers', Wiley Eastern Limited, 1986.
2. Lander,W., 'Power Electronics', McGraw Hill and Company, Third Edition, 1993
3. Vedam Subramaniam, "Power Electronics", New Age International (P) Publishers Ltd., 2000.

## **ENGINEERING MANAGEMENT**

### **SEMESTER VI**

**(Common to EEE & EIE)**

#### **1. ENGINEERING ECONOMICS**

**9**

Introduction - Demand and Revenue Analysis - Demand Forecasting - Production Analysis - Cost and Supply Analysis, Price and output Determination - Investment Analysis - Plant Location - Economic Optimization.

#### **2. MANAGEMENT OF WORK**

**9**

Types of Business Organisation, Forms, Planning - Organising - Coordination , Directing.

#### **3. THE MANAGEMENT OF ENGINEERS**

**9**

Human Resource Development – Motivation- Leadership - Team working and Creativity - Managerial Communication - Personal Management – Time Management - Stores Management - Career Planning.

#### **4. THE MANAGEMENT OF ENGINEERING**

**9**

Financial Management - Product development - Management techniques in product development - Nature of controlling - Operations Management - Just-in-Time.

#### **5. CONTEMPORARY MANAGEMENT ISSUES**

**9**

Managing World Economic Change - The global environment - Multinational Strategies - Economic Cycles - Organisation Change and Organisation Development - Managerial Ethics and Social responsibilities.

**Total hours: 45**

#### **TEXT BOOKS:**

1. Gail Freeman - Bell and Janes Balkwill, " Management in Engineering - Principles and Practice ", Prentice Hall of India Pvt.Ltd., 1998.
2. Gene Burton and Manab Thaker, " Management Today Principles and Practice ", Tata McGraw Hill, 1995.

#### **REFERENCES:**

1. M. Joesph, Putti Management - " A Functional Approach ", McGraw Hill, 1999.
2. R.R. Barathwal, " Engineering Economics ", McGraw Hill, 1997.

## SEMESTER V I

### ANALYTICAL INSTRUMENTS

- 1. pH CONDUCTIVITY & DISSOLVED COMPONENT ANALYSER 8**  
Sampling systems – ion selective electrodes – conductivity meters – pH meters – dissolved oxygen analyser – sodium analyser – silica analyser – moisture measurement.
- 2. GAS ANALYSER 8**  
Oxygen analyser – CO monitor – NO<sub>2</sub> analyser – H<sub>2</sub>S analyser – dust and smoke measurement – thermal conductivity type – thermal analyser – industrial analysers.
- 3. CHROMATOGRAPHY 10**  
Gas chromatography – Liquid chromatography – Principles, types and applications – high pressure liquid chromatography – detectors
- 4. SPECTRO PHOTOMETERS 10**  
Spectral methods of analysis – Beer's Law – UV – Visible spectrophotometers – single beam and double beam instruments – sources and detectors – IR spectrophotometers – sources and detectors – FTIR spectrometers – atomic absorption spectrophotometers – flame emission spectrophotometers – sources of flame photometry – applications.
- 5. NUCLEAR MAGNETIC RESONANCE AND RADIATION TECHNIQUES 9**  
NMR – basic principle – NMR spectrometers – applications – introduction to mass spectrophotometers – nuclear radiation detectors – GM counter – proportional counter – solid state detectors – introduction to x- ray spectroscopy

**Total Hours 45**

### TEXT BOOKS

1. Willard, H.H., Merrit L.L., Dean J.A Seattle F.L., 'Instrumental Methods of Analysis', CBS Publishing and Distribution, 1995
2. Robert D.Braun, Introduction to Instrumental Analysis, McGraw–Hill, Singapore, 1987.

### REFERENCES

1. Skoog, D.A. and West D.M., Principles of Instrumental Analysis, Holt Sounder Publication, Philadelphia, 1985
2. Ewing G.W., Instrumental Methods of Analysis', McGraw-Hill, 1992
3. Mann C.K. Vickers, T.J. and Guillick W.H Instrumental Analysis, Harper and Row Publishers, New York, 1974.
4. Liptak, B.G, Process Measurement and Analysis, Chilton Book Company, 1995
5. Frank A.Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, New Jersey, 1997

## **SEMESTER V I**

### **PRACTICAL**

#### **INDUSTRIAL INSTRUMENTATION LABORATORY**

(Any TEN experiments)

1. Discharge coefficient of orifice plate
2. Calibration of pressure gauge
3. Calibration of thermocouple
4. Calibration of flowmeter
5. Torque measurement
6. Viscosity measurement
7. Vacuum pressure measurement
8. Level measurement using d/p transmitter
9. UV – Visible spectrophotometer
10. IR spectrophotometer
11. pH meter standardisation and measurement of pH values of solutions
12. Conductivity meter calibration and measurements of conductivity of test solutions.

**Total Hours 45**

## **SEMESTER V I**

### **PROCESS CONTROL LABORATORY**

(Any TEN experiments)

1. Operation of interacting and non-interacting systems
2. Responses of different order processes with and without transportation lag
3. Response of on-off controller
4. Response of P+I+D controller
5. Characteristics of control valve with and without positioner
6. Operation of on-off controlled thermal process
7. Closed loop response of flow control loop
8. Closed loop response of level control loop
9. Closed loop response of temperature control loop
10. Closed loop response of pressure control loop
11. Tuning of controllers
12. Study of complex control system (ratio / cascade / feed forward)

**Total Hours 45**