

## 5.1 BIOMEDICAL INSTRUMENTATION

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### RATIONALE

Recent advances in medical field have been fuelled by the instruments developed by the Electronics and Instrumentation Engineers. Pacemakers, Ultrasound Machine CAT, Medical diagnostic systems are few names which have been contributed by engineers. Now health care industry uses many instruments which are to be looked after by instrumentation engineers. This subject will enable the students to learn the basic principles of different instruments/equipment used in the health care industry. The practical work done in this area will impart skill in the use, servicing and maintenance of these instruments/equipment. Proficiency in this area will widen the knowledge and skill of diploma holders in the field of biomedical instrumentation.

### DETAILED CONTENTS

1. Anatomy and Physiology (10 hrs)

Elementary ideas of cell structure, heart and circulatory system, control nervous system, Musculo-skeletal system, Respiratory system Body temperature and reproduction system.

2. Classification of Biomedical Equipment (2 hrs)

Diagnostic, therapeutic and clinical laboratory equipment

3. Bioelectric signals and their recording (14 hrs)

Bioelectric signals (ECG, EMG, ECG, EOG & ERG) and their characteristics, Bio-electrodes, electrodes tissue interface, contact impedance, effects of high contact impedance, types of electrodes, electrodes for ECG, EEG and EMG.

4. Transducers for Biomedical Application (12 hrs)

Resistive transducers - Muscle force and Stress (Strain guge), Spirometry (Potentiont) , humidity, (Gamstrers), Respiration (Thermistor)

Inductive Transducers - Flow measurements, muscle movement (LVDT)

Capacitive Transducers - Heart sound measurement, Pulse pick up

Photoelectric Transducers - Pulse transducers, Blood pressure, oxygen Analyses

Piezoelectric Transducers - Pulse pickup, ultrasonic blood flowmeter

Chemical Transducer - Ag-Agfallas (Electrodes, PH electrode

5. Bioldectric Signal recording machines (8 hrs)  
Physiological pre-amplifier and specialized amplifiers, ECG lead systems details of ECG, EMG, and EEG machines
6. Patient Monitoring system (6 hrs)  
Heart rate measurement pulse rate measurement, respiration, rate measurement, blood pressure measurement, microprocessor applications in patient monitoring
7. X- Ray Machine (6 hrs)  
Basic X-Ray components and circuits, types of X-ray machines e.g. general purpose, dental image intensifier system, table shooting and maintenance of X- Ray machine
8. Safety Aspect of Medical ..... (4 hrs)  
Gross current, Micro Current shock, safety standards rays and considerations, safety testing instruments, biological effects of X-rays and precautions

#### **LIST OF PRACTICALS**

1. Minimum of eight exercises to be carried out and one field visit
2. Operation and function of all the controls of hospital X-Ray machine (visit at hospital)
3. Operation and function of all the controls of dental X-Ray machine (Visit to Hospital)
4. Identification of different block/sub system of circuits in X-Ray machine
5. Measurement of skin contact impedance and technique to reduce it.
6. Observe its wave shape on CRO the output of blood pressure transducers body temperature transducers and pulse sensors
7. Use of sphygrmanometer for measurement of blood pressure
8. Concept of ECG system and placement of electrodes
9. Measurement of leakage currents with the help of safety tester
10. PH measurement of given biological sample
11. Concept of EMG system and placement of electrode
12. Measurement of respiration rate using thermistor
13. Concept of EEG system and placement of electrode
14. Identification of different types of PH electrode

**RECOMMENDED BOOKS**

1. Medical Instrumentation by John. G. Webster –John Wiley
2. Principles of Applied Biomedical Instrumentation by Goddes & Baker – John Wiley
3. Biomedical Instrumentation & Measurement by Carr & Brown-Pearson
4. Biomedical Instrument by Cromwell-Prentice Hall of India, New Delhi
5. Hand book of Medical instruments by R.S. Khandpur –TMH, New Delhi
6. Medical Electronics and Instrumentation by Sanjay Guha – University Publication
7. Introduction to Biomedical electronics by Edward J. Bukstein –sane and Co. Inc. USA

## **5.2 POWER ELECTRONICS**

### **(Common with Electronics and Communication Engineering)**

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#### **RATIONALE**

Power electronics play a very vital role in the field of electronics and control engineering. It is specially applied in the modern industries as they mostly use efficient, effective and precise controls as the old magnetic and electrical control schemes have largely become obsolete. A diploma holder in electronics and instrumentation and control has to maintain the panels used in modern control processes. It is obvious that the knowledge of components such as thyristors, and other semiconductor devices used in such control circuits is very essential for them in order to supervise the work efficiently and effectively. Looking into its usefulness and importance, this subject has been incorporated in the curriculum.

#### **DETAILED CONTENTS**

1. Introduction to thyristors and other power Electronics devices (12 hrs)
  - 1.1 Construction, working principles of SCR two transistor analogy of SCR, VI characteristics of SCR
  - 1.2 SCR specifications and ratings
  - 1.3 Different methods of SCR Triggering
  - 1.4 Different commutation circuits for SCRs
  - 1.5 Series and parallel operations of SCRs
  - 1.6 Basic idea about the selection of heat sinks for thyristers
  - 1.7 Construction and working principle of Diacs and Triacs and their V-I characteristics
  - 1.8 Construction, working and ratings of Gate Turn Off (GTO) thyristors
  - 1.9 Characteristics of SCR diac. Triac, programmable uni-junction transistor (PUT), ASCR, RCT, LASCR, SCS
  - 1.10 Contribution and working of UJT and its application as relaxation oscillator
  - 1.11 Comparison between BJT and SCR
  - 1.12 Construction, working and characteristics of MOSFET, IGBT, MLT, their specifications and ratings
  
2. Application of SCR and Triacs (8 hrs)
  - 2.1 Illumination control
  - 2.2 Temperature control
  - 2.3 Battery charger
  - 2.4 Fan regulators
  - 2.5 Emerging light using SCR
  - 2.6 Speed control of DC and universal motor
  - 2.7 LDR operated SCR circuit
  - 2.8 Switched mode power supply

- 2.9 Uninterrupted power supply
- 2.10 Solid state relays
- 3. Controlled Converters (10 hrs)
  - 3.1 Half wave controlled rectifier with resistive load
  - 3.2 Half wave controlled rectifier with inductive load
  - 3.3 Full wave half controlled rectifier with resistive load
  - 3.4 Full wave half controlled rectifier with inductive load
  - 3.5 Full wave fully controlled rectifier with resistors as well as inductive load
  - 3.6 Three-phase half wave fully controlled rectifier with resistive and inductive load
  - 3.7 Three phase fully wave fully controlled and half controlled with resistive as well inductive loads
  - 3.8 Dual converters and their applications
- 4. Inverters (8 hrs)
  - 4.1 Voltage and current source inverters
  - 4.2 Working principle of single phase series and parallel inverter
  - 4.3 Working principle of single phase bridge inverter
  - 4.4 Working principle of three phase bridge inverter
- 5. Choppers (8 hrs)
  - 5.1 Working of voltage, current and load, commutated choppers
  - 5.2 Classification of choppers
- 6. Cyclo Converter (8 hrs)
 

Working principle of single phase and three phase cyclo converter
- 7. Electric Drive Control (10 hrs)
  - 7.1 d.c. drive control
    - a) Speed control of dc series motor using bridge rectifier
    - b) Speed control of dc shunt motor using bridge rectifier
    - c) Speed control of dc motor using choppers
    - d) Study of control scheme for speed control of a separately excited d.c motor above and below the base speed
  - 7.2 a.c. drive control
    - a) Speed control of induction motors using phase control
    - b) Speed control of induction motors using variable frequency
    - c) Speed control of induction motor using slip power recovery schemes

### **LIST OF PRACTICALS**

1. Testing of components like SCR Triac, BJT, UJT, MOSFET
2. To plot and verify V-I characteristics of an SCR
3. To plot and verify V-I characteristics of a Triac
4. To plot V-I characteristics of UJT
5. To plot V-I Characteristics of a DIAC
6. Fabrication and testing of illumination control circuit using SCR
7. Fabrication of street lights circuit using LDR and Triac
8. Fabrication of speed control circuit for a d.c. motor
9. Fabrication of three phase bridge rectifier using two SCR and two diodes
10. Fabrication of three phase bridge rectifier using diodes
11. Fabrication of transistorized emergency light cum battery charger circuit

### **INSTRUCTIONAL STRATEGY**

The teacher may encourage students to perform practical simultaneously for better understanding of the subjects and verification of theoretical concepts. The various components must be shown to the students for identification and also tested. Practical applications of the various circuits and devices should be discussed in the class. The available video films on the subject must be shown to the students.

### **RECOMMENDED BOOKS**

1. Industrial Electronics and Control by SK Bhattacharya and S Chatterji; New Age Publishers, New Delhi
2. Electrical and Electronic Measurements by A.K.Sawhney, Dhanpat Rai and Sons, New Delhi
3. Power Electronics – Principles and Application by J Michael Jacob; Vikas Publishing House, New Delhi
4. Power Electronics by M.H.Rashid.
5. Power Electronics by P.C. Sen, Tata McGraw Hill Publishers, New Delhi

6. Thyristors by M.S. Berde, Khanna Publishers, New Delhi
7. Thyristors and Thyristors by Sugandhi and Sugandhi.
8. Power Electronics by P.S. Bhimbhrah, Khanna Publishers, New Delhi
9. Fundamentals of Power Electronics by S. Rama Reddy, Narosa Publishing House, New Delhi

**5.3 (Elective-I)**  
**5.3(a) INTELLIGENT INSTRUMENTATION**

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**RATIONALE**

The elective subject will enable diploma engineers to specialize in this area which is gaining lot of importance in industries in accomplishment of automation, data acquisition and analysis tools will enable him to operate and maintenance intelligent instrumentation systems efficiency.

**DETAILED CONTENTS**

1. Review of Virtual Instrumentation (10 hrs)  
 Historical perspective, advantages etc., block diagram and architecture of a virtual instrument
2. Data-Flow Techniques (10 hrs)  
 Graphical programming in data flow, comparison with conventional programming
3. VI Programming Techniques (16 hrs)  
 Vis and Sub-Viz, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O
4. Data acquisition basics (10 hrs)  
 ADC, DAC, DIO, counters and timers, PC hardware structure, timing, interrupts, DMA software and hardware installation
5. Common instrumentation interfaces (8 hrs)  
 Current loop RS232C/RS485, GPIB
6. Use of Analysis Tools (12 hrs)  
 Some tools from the advanced analysis tools relevant to the discipline may be included e.g., Fourier transformer, power spectrum, correlation methods, windowing and filtering
7. Applications of VI:IV Application in various fields (10 hrs)

**RECOMMENDED BOOKS**

1. Lab VIEW Graphical Programming by Gary Johnson, McGraw Hill, New York
2. Lab VIEW for Everyone, Lisa K Wells and Jertrey Travis, Prentice Hall
3. Basic concepts of Lab VIEW 4 by Sokoloft, Prentice Hall
4. PC Interfacing for Data Acquisition and Process Control by S. Gupta, JP Gupta, Instrument Society of America

**5.3 (Elective-I)**  
**5.3(b) ADVANCED MICROPROCESSORS**

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**RATIONALE**

The complex systems require high through put that at times is not met with 8-bit microprocessor system, so 16 bit microprocessors based system become suitable and economical, they provide better facilities to personal computers and other industrial systems in variable use 16 bit microprocessor. This course will also provide familiarization with the interfacing techniques.

**DETAILED CONTENTS**

- |    |   |          |
|----|---|----------|
| 1. | Introduction  | (16 hrs) |
|    | Internal architecture of 8086., internal registers, physical and logical address generation, maximum and minimum modes, clock generation, minimum system, comparison between 8086 and 8088  |          |
| 2. | Programming 8086  | (16 hrs) |
|    | Addressing modes, instruction format, instruction templates and hand assembly instruction set data transfer, arithmetic, bit manipulation, string instructions, program transfer, and processor control instructions, assembler and assembler directives. |          |
| 3. | Programming   | (10 hrs) |
|    | Exercises based on the instruction set and use of assembler   |          |
| 4. | Memory and I/O Interface  | (6 hrs)  |
|    | Memory interface block diagram, I/O interface (direct and indirect)   |          |
| 5. | Interrupt Interface of 8086   | (6 hrs)  |
|    | Types of interrupts, interrupt masking, software interrupts   |          |
| 6. | Introduction to 32 bit Microprocessors  | (12 hrs) |
|    | 80386, 80486 and pentium, block diagrams and features   |          |
| 7. | Brief idea of Interfacing Chips   | (14 hrs) |
|    | 8257, 8253, 8279, 8259, 8251 and 8155   |          |

## LIST OF PRACTICALS

1. Study of instructions of 8086 using Debug
2. Addition and subtraction of multi-byte numbers
3. Multiplication of unsigned/signed numbers
4. Division of unsigned/signed numbers
5. Sorting strings in ascending and descending order
6. Modular programming using subroutines
7. Program to reverse a string interfacing using chips
8. Use of 8279 for (seven segment display)
9. Use of 8155 (for serial communication)
10. Traffic light controller by using 8253

**Note: Programming should be done on computer using assembler**

## INSTRUCTIONAL STRATEGY

The teacher may take help of charts, simulation packages for giving in depth knowledge of the subject to the students. Sufficient programming and interfacing exercises on microprocessors should be given to the students. The practical programming exercises may be performed on the microprocessor kit as well as on computer using TASM or MASM assemblers

## RECOMMENDED BOOKS

1. Microprocessor and Application by D.V. Hall.
2. 8051 Micro Controller.
3. Microprocessor 8086/88 by B.B. Brey
4. Microprocessors & Micro controllers by Dr. B.P. Singh
5. Microprocessor by Rajiv Sapra, Ishan Publications, Ambala
6. Microprocessor by Naresh Grover
7. Microprocessors and Microcomputers and their Applications by AK Mukhopadhyay
8. Microprocessors and Applications by Uffenback
9. Introduction to Microprocessor by Adithya Mathur, Tata McGraw Hill Publishing Co, New Delhi
10. Microprocessor Architecture, Programming and Applications with 8085 by RS Gaonkar, Wiley Eastern Ltd, New Delhi
11. Microprocessor and Applications by B Ram
12. Microprocessor by SK Goel
13. 8051 by Mcakenzie, Prentice Hall of India, New Delhi

**5.3 (Elective-I)****5.3 (c) OPTO ELECTRONIC DEVICES AND THEIR APPLICATIONS**

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**RATIONALE**

To impart latest developments in the Opto electronic devices and fiber optics in the field of measurement and instrumentation technology, this subject is included in the syllabus.

**DETAILED CONTENTS**

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|----|---|----------|
| 1. | Introduction  | (10 hrs) |
|    | 1.1 Classification of optical fiber                           |          |
|    | 1.2 Principle of light transmission through fiber             |          |
|    | 1.3 Fabrication of optical fibers                             |          |
|    | 1.4 Material consideration                                    |          |
|    | 1.5 Loss and band width limiting mechanism                    |          |
|    | 1.6 Mechanical and thermal characteristics                    |          |
|    | 1.7 Light sources for fiber optics                            |          |
|    | 1.8 Photo detectors   |          |
|    | 1.9 Source coupling   |          |
|    | 1.10 Splices and connectors                                   |          |
| 2. | Fundamentals of Optics  | (8 hrs)  |
|    | Polarization, diffraction, interference, dispersion holograms |          |
| 3. | Optical Sources   | (10 hrs) |
|    | 3.1 Light Emitting Diodes (LEDs)                              |          |
|    | - Structure   |          |
|    | - Materials   |          |
|    | - Characteristics   |          |
|    | - Efficiency  |          |
|    | 3.2 Liquid Crystal Display (LCD)                              |          |
| 4. | Photo Detectors   | (10 hrs) |
|    | - Thermal detectors   |          |
|    | - Photo detectors   |          |
|    | - Vacuum photo diode  |          |
|    | - Photo multiplier tube                                       |          |
|    | - Photo conductive detector                                   |          |
|    | - LDR   |          |
|    | - PIN diode   |          |
| 5. | Optical Instruments   | (12 hrs) |
|    | - Optical pyrometer   |          |
|    | - Infrared thermometer  |          |
|    | - Polarimeter   |          |

- Light intensity meter
  - Spectro photo meter
  - Spectrum analyzer
  - X-ray fluoroscopic instruments
  - Periscope
  - Optical filters
  - Beam splitters
6. Lasers (10 hrs)
- 6.1 Fundamentals of laser emission
- 6.2 Different types of lasers
- Gas laser
  - Liquid lasers
  - Semiconductor lasers
7. Use of Lasers (10 hrs)
- For measurement of distance
  - For measurement of velocity
  - For measurement of acceleration
  - For measurement of length
8. Industrial Application of Laser (10 hrs)
- 8.1 Laser heating
- 8.2 Laser melting
- 8.3 Laser welding

**Note:**

**Visit to industry (laboratories/Research and Development Centre) to demonstrate the characteristics and functioning of LED, photo detection, working of various optical instruments, lasers, fibre option. Organizations like CSIO, Chandigarh, TTTI, Chandigarh can be contacted.**

**RECOMMENDED BOOKS**

1. Optical fiber Communication by John M Senior, Prentice Hall of India, New Delhi
2. Optical fiber Communication by J. Gower, Prentice Hall of India, New Delhi
3. Optical fiber Communication by ‘ Gerd Keiser, McGraw Hill International Editions
4. Optical Communications – Components and Systems by JH Franz and VK Jain, Narosa Publishing House, New Delhi
5. Optical fiber Communication Systems by GP Agrawal, John Wiley & Sons, New Delhi
6. Optical fiber Communication and its Applications by S C Gupta, Prentice Hall of India, New Delhi

**5.3 (Elective-I)**  
**5.3(d) ADVANCED MEASUREMENT TECHNIQUES**

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**RATIONALE**

The syllabus has been designed to impart advanced knowledge about various measurement systems to the students. These concepts will help the students in learning advanced measurement techniques comprising optical vibration, high frequency, ultrasonic etc.

**DETAILED CONTENTS**

1. Review of Measurement System (10 hrs)
  - Functional elements of a measuring system
  - Input – output configuration of instrumentation system
  - Method of correction for interfering and modifying inputs
  
2. Measurement of Vibration (16 hrs)
  - Nature of vibration
  - Quantities involved in vibration measurements
  - Seismic transducer
  - Types of accelerometers – potentiometric type accelerometer, LVDT accelerometer, Piezo electric accelerometer
  
3. High Frequency Measurement (20 hrs)
  - Resonance methods
  - Measurement of inductance and capacitance
  - Measurement of effective resistance by resistance variation method and reactance variation method
  - T networks – parallel T networks and bridge T networks
  - Radio frequency measurement – sensitivity and selectivity measurement of radio receiver
  
4. Opto Electronic Measurement (20 hrs)
  - Photo sensitive devices – light emitting diodes, photo diodes, photo conductors
  - Photo voltaic cell, photo thyristors, photo transistors
  - Light modulating techniques – light suppression, light attenuation, photometric and radiometric fittings
  
5. Ultrasonic Measurement (14 hrs)
  - Ultrasonic method of flow measurement, and measurement of thickness, measurement of displacement etc
  - Ultrasonic digitizer

**INSTRUCTIONAL STRATEGY**

This being an advanced subject the teacher should lay emphasis on fundamental concepts for measurement techniques. Field application of various transducers should be dealt thoroughly. For exposure the students may be taken to industry

**RECOMMENDED BOOKS**

1. Measurement systems, Application and Design – E.O Doebelin, McGraw Hill International Editions
2. A Course in Electrical and electronics Measurement and Instrumentation by AK Sawhney; Dhanpat Rai and Co Pvt. Ltd., New Delhi

## 5.4 PROCESS CONTROL

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### RATIONALE

For the student, early emphasis on automatic control is vital since a process designed and constructed with proper consideration for its control is most likely to be successful in practice.

This course introduces various control mechanisms, modes and devices which are necessary to understand simple control systems in a process plant. The contents of the course have been selected and arranged so as to treat it in a logical manner, to understand the important laws of operation of industrial automatic control systems and to provide a practical background of theory. The course will enable the student to visualize and evaluate the effect of changes in process parameters on the control response.

### DETAILED CONTENTS

1. Basic Control Loops and Characteristics (12 hrs)  
Basics of process control, process variables, open loop and closed loop control, single capacity level, thermal, flow loop and other process system. Two capacity and multicapacity processes. Process Log, Measurement lag, transmission lag, dead time.
2. Controller Modes and Characteristics (12 hrs)  
Concept of on-off, proportional, integral, derivative, PI, PD & PID, Examples. Relative merits and demerits, Response of different control modes to step and ramp test inputs.
3. Electrical Control Elements (12 hrs)  
Construction and principle of operation of solenoids, stepper motor, AC/DC motor, limit switches, relays, auto transformer, magnetic amplifiers.
4. Pneumatic control elements (12 hrs)  
Pneumatic pressure supply, pneumatic actuator, pneumatic relay, pressure switches, power cylinders, contractors, electro-pneumatic relays
5. Hydraulic control elements (12 hrs)  
Hydraulic actuators, hydraulic valves

6. Control valves (10 hrs)

Principle of operation and constructional details of solenoid valves, diaphragm operated valve, piston operated valve, valve positioners, control valve characteristics and their sizing, temperature switches flow switches, interlocking and sequencing circuits.

7. Computer Control system (10 hrs)

Introduction to DDC and their application in process industries

### **LIST OF PRACTICALS**

1. To control the level of fluid with the help of on-off control system.
2. To study the control loop of a system of a flow control
3. To find the differential gap of on-off control system
4. To rig up an electronic proportional controller unit
5. To rig up an electronic proportional integrated controller unit
6. To rig up an electronic PID controller and verify its working
7. To study the characteristics and controller specifications of different types of control valves and other repair and maintenance
8. Repair and maintenance of mechanical and electronic relays
9. To make a control circuit using various switches
10. To study and obtain Input/Output relationship of a pneumatic relay

### **INSTRUCTIONAL STRATEGY**

Along with theoretical inputs, visits to process plants must be organized where the students will be exposed to various types of control actions. Small projects in the form of control loops may be identified and given to students as assignments. They are expected to freeze the specifications of various control elements of this loop, prepare related scheduling and costing documentation.

### **RECOMMENDED BOOKS**

1. Process Control by Harrist P; McGraw Hill

2. Automatic Process Control by Eckman D P; Wiley Eastern, 1975
3. Instrument Engineers Handbook by Liptak B. G.; 3<sup>rd</sup> edition
4. Process Control Instrumentation Technology by Johnson, Curtis D; John Wiley and Sons
5. Automated Process Control Systems: Concepts and Hardware by Ronald P Hunta, PE, Prentice Hall Inc., New Delhi
6. Principles of Industrial Process Control; by Eckman, Donal P; John Wiley and Sons
7. Process Measurement and Analysis, third edition by Liptak Bila G

## 5.5 PROCESS INSTRUMENTATION

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### RATIONALE

This course will enable the students to evaluate the complexity of different process variables in industry, which includes different process measuring instruments and related transducers. The students will appreciate the importance and limitations of different types of process controls and actual controlling aspects, hence this subject.

### DETAILED CONTENTS

1. Introduction: Trends in process control, selection of key variables for process control, hydraulic, pneumatic and electronic instrumentation  
(6 hrs)
2. Flow Measurement: Construction, working principle, selection criteria and application of flow measurement with orifices, magnetic, ultrasonic, vortex flow meters, turbine flow meter and rotameter.  
(16 hrs)
3. Level Measurement : Construction, working principle, selection criteria and application of level detectors, float level devices, level gauges, optical level devices, radiation level sensors, thermal level sensors, level switch .  
(10 hrs)
4. Temp. Measurement: Construction, working principle, selection criteria and application of temp sensors – thermocouples, RTD's, thermistors, radiation pyrometry, IR detectors  
(16 hrs)
5. Pressure Measurement: Construction, Working principle, selection criteria and application of pressure sensors – bellows, diaphragm, bourdon and helical types, electronic pressure sensor, manometers, pressure gauges, vacuum sensors, high pressure sensors, pressure switch.  
(16 hrs)
8. Measure system for Density, pH, humidity, moisture and viscosity measurement  
(16 hrs)

### LIST OF PRACTICALS

1. To measure flow using rotameter
2. To measure flow using venturi tube and V-tube manometer
3. To measure temperature using thermocouple, RTD and thermistor
4. To measure the pH value of given solution

5. Study of characteristics of various transmitters (electronic/pneumatic/hydraulic etc.)
6. To study the characteristics of different types of pressure, flow, level gauges
7. To measure pressure using V-tube manometer

#### **RECOMMENDED BOOKS**

1. Mechanical measurements by AK Sawhney; Dhanpat Rai and Co. New Delhi
2. Process control instrumentation technology by Custis D Johnson: John Wiley and sons
3. Process/Industrial Instruments and Control Handbook by Considine; Douglas M: Magraw Hill
4. Mechanical Measurement by Becwith and Buch: Pearson
5. Mechanical and Industrial Measurements by RK Jain, Khanna Publisher, New Delhi

## 5.6 MINOR PROJECT WORK

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Minor project work aims at exposing the students to the industries dealing with electronics components, devices, circuits and micro processors, They are expected to learn about the working principles of different electronic and micro-process based instruments. It is expected that students get acquainted with environment at the shop floor. Depending upon the interest of students they are sent to:

1. Instrumentation development centres/industries
2. Microprocessor application oriented industries
3. Computer aided controls industries
4. Control-panel designing, fabrication and installation industry
5. Medical electronics industries
6. Repair and maintenance work shops
7. Consumer electronic goods industries
8. PC based temperature measurement, display and control using thermocouple; LM 334/35
9. Interfacing of various devices with PC and their switching through relays
10. Design a parallel port-data acquisition card using ADC 804; DAC 804
11. PC as a function generator
12. PC based automatic jar filling system
13. PC based pressure measurement and control system
14. Tele-medicare
15. Communication industry and Telephone Exchange.
16. Various microprocessor oriented industries
17. Micro processor based control system industries
18. Medical electronics industries
19. Repair and maintenance work shops

As a minor project activity each student is supposed to study operations and prepare a detailed project report of the observations /processes/activities by him/her. The students will be guided by respective subject teacher and each teacher may guide a group of 4 to 5 students. The teacher along with field supervisors/engineers will conduct performance assessment of students.

Criteria for assessment will be as follows:

| Criteria  | Weightage |
|---|-----------|
| a) Attendance and punctuality                           | 15%       |
| b) Initiative in performing tasks / clearing new things | 15%       |
| c) Relation with people                                 | 15%       |
| d) Report writing and seminar                           | 55%       |