# Course Scheme for Integrated Certificate and Diploma

# in

# Instrumentation and Control Engineering

**Department of Electrical & Instrumentation Engineering**
**Sant Longowal Institute of Engineering & Technology**
**Longowal-148106**
**Phone: 01672-253119/253120 Fax: 01672-280057**
**Website:www.sliet.ac.in**

# Vision of Department

Electrical and Instrumentation Engineering department shall strive to act as a podium for the development and transfer of technical competence in academics, entrepreneurship, and research in the field of Electrical and Instrumentation Engineering to meet the changing need of society.

## MISSION

1. To provide modular programmes from skill development to the research level
2. To impart Education and training in innovative state-of-the-art technology in the field of Electrical and Instrumentation Engineering.
3. To promote Promotion of holistic development among the students
4. To provide extension services to rural society, industry professionals, institutions of research and higher learning in the field of Electrical and Instrumentation Engineering.
5. To interact with the industry, educational and research organizations, and Alumni in the fields of curriculum development, training and research for sustainable social development and changing needs of society.

## PROGRAMME EDUCATIONAL OBJECTIVES (PEO):

The following Programme Educational Objectives are designed based on the department mission. The Certificate/ Diploma holders of Instrumentation and Control Engineering should be able to demonstrate

1. skill in professional/academic career using the knowledge of basic engineering principles.
2. ability in solving real life problems related to electrical engineering.
3. sustained learning and adaptation to modern engineering tools, techniques and practices through instruction, group activity and self-study
4. team work while working with diverse multidisciplinary/interdisciplinary groups.
5. professional ethics and commitment organizational goals

## PROGRAMME OUTCOMES (PO):

Instrumentation and Control Engineering Certificate/ Diploma holders of the SantLongowal Institute of Engineering & Technology, Deemed University, Longowal will have ability to:

(i) **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

(ii) **Problem analysis:** Identify and analyze well-defined engineering problems using codified standard methods.

(iii) **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.

(iv) **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

(v) **Engineering practices for society, sustainability, and environment:** Apply appropriate technology in context of society, sustainability, environment, and ethical practices.

(vi) **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

(vii) **Life-long learning:** Ability to analyze individual needs and engage in updating in the context of technological changes.

# SCHEME
# of
# Integrated Certificate and Diploma in Instrumentation and Control

| DEPARTMENT OF ELECTRICAL AND INSTRUMENTATION ENGINEERING | | | | | | | |
|---|---|---|---|---|---|---|---|
| THREE YEAR INTEGRATED CERTIFICATE DIPLOMA PROGRAM | | | | | | | |
| CERTIFICATE IN INSTRUMENT MECHANIC, DIPLOMA IN INSTRUMENTATION AND CONTROL ENGINEERING | | | | | | | |
| **Semester-I (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | AM-111 | Mathematics- I | 4 | 1 | 0 | 5 | 5 |
| 2 | PH-111 | Physics-I | 4 | 0 | 2 | 6 | 5 |
| 3 | CY-111 | Chemistry-I | 4 | 0 | 2 | 6 | 5 |
| 4 | HU-111 | Communication Skills-I | 2 | 0 | 0 | 2 | 2 |
| 5 | IE-111 | Workshop Practice-I(department specific)/ Departmental course | 0 | 0 | 2 | 2 | 1 |
| 6 | EE-111 | Basic Electrical Engineering | 3 | 0 | 2 | 5 | 4 |
| 7 | ME-111 | Engineering Drawing | 0 | 0 | 4 | 4 | 2 |
| | | Total | 17 | 1 | 12 | 30 | 24 |
| **Semester-II (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | AM-121 | Mathematics- II | 4 | 1 | 0 | 5 | 5 |
| 2 | PH-121 | Physics-II | 4 | 0 | 2 | 6 | 5 |
| 3 | CY-121 | Chemistry-II | 4 | 0 | 2 | 6 | 5 |
| 4 | HU-121 | Communication Skills-II | 1 | 0 | 2 | 3 | 2 |
| 5 | WS-122 | Workshop Practice | 0 | 0 | 3 | 3 | 2 |
| 6 | CS-121 | Computer Fundamentals | 3 | 0 | 2 | 5 | 4 |
| 7 | IE-121 | Measurement Science | 3 | 0 | 0 | 3 | 3 |
| | | Total | 19 | 1 | 11 | 31 | 26 |
| **Semester-III A (ICD)** | | | | | | | |
| | TP-201 | Two Weeks Practical Training during summer vacations | | | 5 | 80 | S/US |
| **Semester-III B (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | IE-211 | Electrical Measurements | 3 | 0 | 2 | 5 | 4 |
| 2 | IE-212 | Sensors and Transducers | 3 | 0 | 2 | 5 | 4 |
| 3 | IE-213 | Hydraulic and Pneumatic Instruments | 3 | 0 | 2 | 5 | 4 |
| 4 | IE-214 | Electrical and Instrumentation Drawings | 0 | 0 | 4 | 4 | 2 |
| 5 | IE-215 | Electromagnetic Energy Conversion | 3 | 0 | 2 | 5 | 4 |
| 6 | EC-211 | Fundamental of Electronics Engineering | 3 | 0 | 2 | 5 | 4 |
| 7 | MC-211 | Moral values and Professional ethics | 1 | 0 | 0 | 1 | 0 |
| | | Total | 16 | 0 | 14 | 30 | 22 |
| **Semester-IV (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | AM-221 | Applied Mathematics | 3 | 1 | 0 | 4 | 4 |
| 2 | IE-221 | Human Physiology and Medical Instruments | 3 | 0 | 0 | 3 | 3 |
| 3 | IE-222 | Maintenance and Troubleshooting of Instruments | 0 | 0 | 3 | 3 | 1 |
| 4 | IE-223 | Process Control | 3 | 0 | 2 | 5 | 4 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 5 | IE-224 | Analog and Digital Electronics | 3 | 0 | 4 | 7 | 5 |
| 6 | IE-225 | Mechanical Measurements-I | 3 | 0 | 0 | 3 | 3 |
| 7 | IE-226 | Electronic Measurements | 3 | 0 | 2 | 5 | 4 |
| | | Total | 18 | 1 | 11 | 30 | 24 |
| **Semester-V A (ICD)** | | | | | | | |
| | TP301 | Four Weeks Industrial Training during summer vacations | | | 10 | 160 | |
| **Semester-VB (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | MC-311 | Environmental Studies | 2 | 0 | 0 | 2 | 2 |
| 2 | HU311 | Entrepreneurship | 2 | 0 | 0 | 2 | 2 |
| 3 | IE-311 | Control Engineering | 3 | 0 | 2 | 5 | 4 |
| 4 | IE-312 | Analytical & Biomedical Instrumentation | 3 | 0 | 2 | 5 | 4 |
| 5 | IE-313 | Data Acquisition Systems | 3 | 0 | 2 | 5 | 4 |
| 6 | IE-314 | Mechanical Measurements-II | 3 | 0 | 2 | 5 | 4 |
| 7 | IE-315 | Microprocessor and Microcontroller | 3 | 0 | 2 | 5 | 4 |
| 8 | TP-301E | Industrial Training (Evaluation only) | | | | | S/US |
| | | Total | 19 | 0 | 10 | 29 | 24 |
| **Semester-VI (ICD)** | | | | | | | |
| **S.No** | **Sub Code** | **Subject Name** | **L** | **T** | **P** | **Hrs.** | **Credits** |
| 1 | IE-321 | Elements of Computer Programming | 2 | 0 | 2 | 4 | 3 |
| 2 | IE-322 | Case Studies of Process Plants | 3 | 0 | 2 | 5 | 4 |
| 3 | ME-326 | Fundamental of Mechanical Engineering | 3 | 0 | 0 | 3 | 3 |
| 4 | IE-323 | Industrial Automation and Safety | 3 | 0 | 2 | 5 | 4 |
| 5 | IE-324 | Power Electronics and Drives | 3 | 0 | 2 | 5 | 4 |
| 6 | IE-325 | Telemetry and Display Devices | 2 | 0 | 0 | 2 | 2 |
| 7 | IE-326 | Project | 0 | 0 | 4 | 4 | 2 |
| | | Total | 16 | 0 | 12 | 28 | 22 |

Note:

| | |
|---|---|
| Credits for certificate programme | 96 |
| Credits for ICD programme | 142 |
| Maximum courses in one semester | 7 |
| Maximum Contact Hrs. | 32 |

**Course Assessment methods:**

| DIRECT | INDIRECT |
|---|---|
| 1. Internal Test I<br>2. Internal Test II<br>3. Quiz<br>4. Assignment/Tutorials<br>5. Seminar<br>6. End Semester Exam | Course End Survey |

**Direct Assessment Method:**

**Evaluation of Courses with Theory Components**

a. Continuous Assessment Examinations (CAE) carrying 50% weightage.
   i. Two minors carry 40% weightage. Average marks of two minors is taken.. Under extraordinary circumstances, a faculty may take third minor of a particular student.
   ii. Qizzes/ Surprise tests carry 10% weightage. At least two multiple choice questions (MCQ) type quizzes of 15 minutes or assignments/tutorials or seminar per semester are required to check his/her involvement in the course.
b. End Term Examination (ETE) carrying 50% weightage. The structure of the question paper shall be as under: -
   i. The question paper shall have three sections and students to attempt five questions which carry equal marks, with weightage shall be given to the numerical type problems, wherever possible.
   ii. Section-I will have one compulsory question of short answer type questions covering whole syllabus. Section-II and Section-III shall contain three questions covering the entire course syllabus and the students need to attempt two questions from each section.

It is mandatory to secure 30% marks from theory component by the student.

**Evaluation of Courses with Practical component**

a. Continuous Assessment Examinations (CAE) carrying 60% weightage.
   i. Continuous assessment in Laboratory/ Practical works (Experiment performance and quizzes etc) caries 40% weightage
   ii. Regularity/ attendance caries 10% weightage.
   iii. Laboratory record caries 10% weightage.
b. End Term Examination (ETE) carrying 40% weightage.
   i. Laboratory Experiment/ Procedure writing/ Tabulation/ Equation as applicable carries 30% weightage.
   ii. Viva voce examination/ Laboratory quiz carries 10% weightage

It is mandatory to secure 30% marks from Practical component by the student.

**Evaluation of Courses with Theory and Practical Components.**

Procedure for evaluation of theory component and practical components is same as detailed above.

a. Theory component has 75% weightage
b. Practical Component has 25% weightage.
c. It is mandatory to secure 30% marks each from Theory and Practical component by the student.
d. In case student fails to secure minimum qualifying marks in any component, E grade will be awarded.

# SYLLABUS
# of
# Integrated Certificate and Diploma in Instrumentation and Control

## IE-111 Instrumentation Workshop Practice

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 0 | 0 | 2 | 1 | 2 |

**Course Outcomes:**

After successful completion of course, the students should be able to
**CO1: define** the use of various hand tools for manufacturing and testing
**CO2: choose** measuring instruments for testing and measurement
**CO3: classify** various chemicals used in instrumentation workshop and their safety precautions
**CO4: discuss** the fabrication techniques of Printed circuit board (PCB)

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | - | 1 | 1 | 1 | - | 3 |
| CO2 | 3 | 1 | - | - | 1 | 1 | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | - | 1 | 1 | 1 | 2 |

**Theory:**

1. Use of Various hand tools for manufacturing and testing e.g. pliers, cutter, crimpers, stripper, screw driver etc.
2. Familiarization, use and practice of measuring instruments for testing and measurement e.g. Analog and Digital Multimeters, Cathode Ray Oscilloscope (CRO), frequency meter, signal generators, signal sources, LCR meter and Integrated Circuit (IC) tester.
3. Use of various chemicals used in instrumentation workshop and safety precautions to be observed.
4. Demonstration of various steps of Printed circuit board (PCB) fabrication techniques:
   a) Identification of PCB board materials, their characteristics, corrosion and its prevention
   b) Photo processing including photo print, etching, buffing, printing, high speed drilling, surface treatment, plated through holes, double sided PCBs.
   c) Assembly of circuits on PCB, soldering and de-soldering techniques, wire shaping, edge connectors.

**Recommended Books-**

1. K S Jamwal , *Maintenance of Electronic Equipment*, DhanpatRai and Sons
2. R S Khandpur, *Modern Electronic Equipment*, Tata McGraw Hill

## EE-111 Basic Electrical Engineering

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: apply** the knowledge of Electrical Engineering principles to solve D.C and A.C. circuits.

**CO2: analyze** the electrical circuits.

**CO3: describe** basic principles of electromagnetism to implement in electrical machines and transformers.

**CO4: identify** and select various electrical machines according to the applications.

**CO5**: **list** the ethical principles for troubleshooting and installation of safety devices as per norms of engineering practice.

**Pre-requisite knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | - | 1 | 1 | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | 2 | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | 1 | 2 |

**Theory:**

| Unit | Main Topics Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Basic Concepts**<br><br>Electric Charge, Current and Electromotive force, Potential and Potential Difference; conductor, semiconductor insulator and dielectric; Electrical Power and Energy; Ohm's Law, Resistance, and colour coding; Capacitance and Inductance, their ratings; Effects of Temperature on Resistance, Series and Parallel Connection of Resistances and capacitances, Kirchoff's Laws and Their Applications | 06 |
| | **AC Fundamentals**<br><br>Concept of Alternating Voltage and Alternating Current, Difference between AC and DC, Various Terms Related with AC Waves; root mean square (RMS) and Average Values, Concept of Phase and Phase Difference, Single Phase and Three Phase Supply; three phase Star-Delta connections, Inter-Relation between phase voltage/current and line voltage/current; Alternating Voltage applied to Pure Resistance, Pure Inductance, Pure Capacitance and their combinations, Concept of Power and Power Factor in AC Circuit. | 08 |
| | **Measuring Instruments**<br><br>Principle and Construction of Instruments used for Measuring Current, Voltage, Power and Energy, Methods and precautions in use of these and other instruments e.g. digital multimeters, oscilloscopes, signal generators etc. | 03 |

| | | |
|---|---|---|
| | **Electrical Safety**<br><br>Electrical Shock and Precautions against it, Treatment of Electric Shock; Concept of Fuses and Their Classification, Selection and Application; Concept of Earthing and Various Types of Earthing, miniature circuit breakers (MCBs), Earth-leakage circuit breakers (ELCBs) and their application. | 04 |
| **Unit-2** | **Electromagnetic Induction**<br><br>Concept of Magnetic Field, Magnetic Flux, Reluctance, Magneto Motive Force (MMF), Permeability; Self and Mutual Induction, Basic Electromagnetic laws, Effects on a Conductor Moving in A Magnetic Field, various losses in magnetic circuits; | 04 |
| | **Electrical Machines and Transformers**<br><br>Elementary concepts of an electrical machine, Basic principle of a motor and a generator, Torque due to interaction of two magnetic fields and the concept of torque angle, Common features of rotating electrical machines, Classification of Electrical machines; Principles, Construction and Working of various machines; Starters: Need, Construction and Operation, need of a transformer, classification, Principles, Construction and Working of a Transformer, Applications of Transformers; | 10 |
| | **Utilization of Electricity**<br><br>Utilization concepts of electricity for electrolysis process e.g., Electroplating and Electro refining, Electrometallurgy and electrotyping etc., Electrochemical Cells and Batteries; Application of Electricity for Heating, Ventilating, and air-conditioning, Melting and other Metallurgical processes, Welding, and illumination. | 04 |
| | **Basic Trouble shooting**<br><br>Basic Testing and faults diagnosis in electrical systems, various tools and their applications, replacement of different passive components e.g., fuses, lamps and lamp holders, switches, cables, cable connectors, electromagnetic relays. | 04 |

**Recommended Books-**


1. E Hugh, *Electrical Technology,* Pearson Education.
2. D P Kothari and I J Nagrath, *Basic Electrical Engineering,* TMH.
3. D P Kothari and I J Nagrath, *Electrical Machines,* TMH.
4. S K Bhattacharya, *Electrical Machines,* TMH.


**List of Practicals: EE-113**

1. Study of various passive components and measuring instruments and their connections in electrical circuits.
2. Verification of Ohm's Law.
3. Verification of Kirchoff's current law (KCL) and Kirchoff's voltage law (KVL).
4. Verification of equivalent resistances in series and parallel connections.
5. Measurement of various characteristic values of a Sinusoidal waveform with the help of CRO.
6. Measurement of voltage, current and power in RL and RLC circuits and verification of phase angle and power factor concept.
7. Study of various types of Earthings.
8. Study of various types of protection devices e.g. fuses, MCBs and ELCBs
9. Verification of Faraday's laws and Lenz's law.

10. Study of various types of DC motors and their starters.
11. Study of various types of AC motors and their starters.
12. Study of various types of transformers and Verification of turn's ratio.
13. Starting and reversing various AC and DC motors.
14. Fault diagnosis and removal in general electrical connection /apparatus.

## IE-121 Measurement Science

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1**: **explain** the basic concept of measurement and generalized measurement system.
**CO2: define** static and dynamic characteristics of measuring instruments
**CO3: recognize** about Measurement error and statistical analysis
**CO4: tabulate** the various units and standards of measurement and their classification
**CO5: identify** different types of Signals and noise in measurement systems

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| Cos | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | - | 1 | 1 | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | 2 | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | 2 | 3 |
| CO4 | 3 | 1 | - | - | 1 | 1 | 2 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br><br>Introduction to measurements, classification of the methods of measurement, types of instruments, elements of a generalized measurement system, input/output configuration of measurement systems. | 08 |
| | **Static Characteristics of the instruments**<br><br>Measurement system performance, static characteristics in detail, error in measurement, loading effects, input/ output impedance, loading effects due to series and shunt connected instruments. | 08 |
| | **Dynamic characteristics of the instruments**<br><br>Dynamic response and analysis, mathematical models of the measurement system, zero, first and second order measurement systems, dynamic response to standard inputs. | 08 |

| | | |
|---|---|---|
| | **Measurement error and statistical analysis**<br><br>Introduction, limiting errors, classification of errors, Limiting errors, combination of quantities with errors, types of errors, statistical analysis of data- average, dispersion and Gaussian distribution curve. | 08 |
| | **Units, Dimensions and standards**<br><br>Units, Dimensions, systems of electrical units, dimensions in electromagnetic and electrostatic systems, Determination of absolute units, standards of measurement and their classification. | 08 |
| | **Signals and noise in measurement systems**<br>Introduction, deterministic and random signals, statistical representation of the random signals, effects of noise and interference on the measurement system, noise sources , method of reducing effects. | 08 |

**Recommended Books-**


1. A K Ghosh, *Introduction to Instrumentation and Control*, Prentice Hall of India, 2005.
2. A.K. Sawhney and PuneetSawhney, *A course on electrical and electronic measurements and instrumentation*, DhanpatRai, 2012.
3. D A Bell, *Electronic Instrumentation and measurement*, 3rd edition, Oxford University Press, 2013.
4. J P. Bentley, *Principles of Measurement System*, 3rd edition, Pearson Education, 2000

## IE-211 Electrical Measurements

| 3 | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: classify** the fundamentals of analog instruments and their classification.

**CO2: comapre** the types of instruments and their pros and cons**.**

**CO3**: **explain** the construction, working of measuring instruments and their proficient use.

**CO4: compare** various methods of electrical parameters measurement.

**CO5: distinguish** various instruments for the measurement of electrical quantities.

**Pre-requisite knowledge:** Physics XII Class standard

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | - | 1 | 1 | 1 | 1 | 3 |
| CO2 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | 2 | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |
| C05 | 3 | 2 | 2 | - | - | 1 | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Analog instruments**<br>Analog instruments, classification of analog instruments, Principles of operations, operating forces, constructional details, control systems, damping systems, Symbols used for analog instruments. | 08 |
| | **Analog voltmeter, ammeter and ohmmeter**<br>Types of instruments, PMMC instruments, shunts and multipliers, ohmmeters-series and shunt type, torque equation moving iron instruments, torque equations, Advantages, disadvantages and their comparison. | 08 |
| | **Measurement of power and energy**<br>Electrodynamometer type of instruments, Power in ac and dc circuits, single phase wattmeter, measurement of power in single and three phase circuits. Energy meter for ac circuits, single phase induction type watt hour meter. | 08 |

| | | |
|---|---|---|
| **Unit-2** | **Measurement of phase and frequency**<br><br>Single phase electrodynamometer and moving iron power factor meters, Frequency meters and their types, phase sequence indicators. | 06 |
| | **Measurement of resistance**<br>Classification of resistances, measurement of medium resistance with voltmeter-ammeter method, Wheatstone bridge and substitution method, measurement of low resistance with the Kelvin double bridge, Potentiometer method, Measurement of high resistance with the direct deflection method, Loss of charge method and megger. | 08 |
| | **AC Bridges**<br><br>General form of ac bridge, Measurement of inductance, capacitance and frequency, Maxwell bridge, Hay bridge, De-Sauty bridge, Schering bridge etc., sources of error and their minimization | 08 |

**Recommended Books-**


1. A.K. Sawhney and PuneetSawhney,*A course on electrical and electronic measurements and instrumentation*,DhanpatRai, 2012.
2. D A Bell, *Electronic Instrumentation and measurement*, 3rd edition, Oxford University Press, 2013.


**List of Practicals: IE-211**

1. Use of multimeter for measuring voltage, current and resistance.
2. To calibrate 1-phase energy meter by direct loading method.
3. To measure the value of earth resistance.
4. To measure power, power factor in a 1-phase circuit, using wattmeter and power factor meter and verify results with calculations.
5. Measurement of power and power factor of a three-phase balance load by 2-wattmeter method.
6. Measurement of voltage, frequency of a Sinusoidal signal with CRO.
7. Measurement of power in a 3-phase circuit using current Transformer (CT), Potential transformer (PT) and 3 phase energy meter.
8. Connecting appropriate instruments at the supply of an installation to measure supply voltage, frequency, power, maximum demand, Phase sequence, energy consumed.
9. Use of LCR meter for measuring inductance, capacitance and resistance.
10. Connection of 3-phase energy meter in an electrical system for Measurement of energy.
11. To determine the input impedance of a multimerter.
12. To determine the error in Measurement in voltage when a multimeter is used and then Digital voltmeter (DVM) (Vacuum Tube Volt Meter (VTVM)) is used.

## IE-212 Sensors and Transducers

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1**: **enumerate** the basic working of various types of sensors and transducers.

**CO2: differentiate** between sensors and transducers.

**CO3: identify** different types of sensors and their use for different applications.

**CO4: explain** the working of various transducers.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | 2 | 2 | - | - | 3 |
| CO3 | 3 | 2 | - | 1 | 1 | 2 | 2 |
| CO4 | 3 | 2 | 2 | 1 | - | 1 | 2 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introductions**<br><br>Definitions and types of transducers, Characteristics and Choice Of Transducers, Factors Influencing The Choice of Transducers | 03 |
| | **Resistive Transducers**<br><br>Construction, working principles, types, applications, advantages and disadvantages of potentiometers and strain gauge, , Resistive temperature transducers(RTD), Thermocouples , Thermistors | 09 |
| | **Inductive Transducers**<br><br>Basic principles of Variable Inductance Transducers, Electromagnetic pick up, Induction potentiometer, Linear variable differential transformer (LVDT) Variable reluctance transducers. | 09 |
| | **Piezoelectric Transducers**<br><br>Basic principle and uses of piezoelectric transducers, Piezoelectric crystals and their properties, General forms of piezoelectric transducers | 03 |

| | | |
|---|---|---|
| **Unit-2** | **Capacitance Transducers**<br><br>Basic principles and types of Variable Capacitance Transducers, frequency response, advantaged disadvantages and uses of capacitive transducers Capacitance pick up, Condenser microphones, Differential capacitor pick up. | 08 |
| | **Digital Encoding Transducers**<br><br>Definition , classification, construction of digital encoding transducers, optical displacement transducers, shaft encoders | 08 |
| | **Photo electric devices**<br><br>Definitions and types photoemissive cells, Photovoltaic, photoconductive cells | 03 |
| | **Other Transducers**<br><br>Load cell, strain gauge and inductive torque meter magnetostrictive transducers electrical tachometers (AC and DC both) | 06 |

**Recommended Books-**


1. C S Rangam, G R Sarma and V S V Mani, *Instrumentation -Devices and Systems*, TMH
2. A.K. Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation*, DhanpatRai
3. E.O. Doeblin, *Measurement Systems*, McGraw Hill
4. B C Nakra, *Instrument Measurement and Analysis* , PHI
5. W.D. Cooper, A.D. Helfrick, *Electronic instrumentation and measurement techniques*, PHI


**List of Practical: IE-212**

1. To study the characteristics of LVDT.
2. To study the characteristics of Variable Capacitor.
3. To study the characteristics of Light dependent resistor (LDR).
4. To study the characteristics of Strain Gauge.
5. To study the characteristics of Crompton Potentiometer.
6. To study the characteristics of RTD.
7. To study the characteristics of Thermistor.
8. To study the characteristics of Thermocouple.

## IE-213 Hydraulic and Pneumatic Instruments

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: define** the fundamental of fluid power system

**CO2: list** the basic of hydraulic system and working of hydraulic components

**CO3: design** hydraulic circuit

**CO4: sketch** the basic of pneumatic system and working of hydraulic components

**CO5: design** of the pneumatic circuit

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | 1 | 1 | - | - | 2 |
| CO3 | 3 | 2 | - | - | 2 | 1 | 2 |
| CO4 | 3 | - | - | 2 | - | - | 2 |
| CO5 | 3 | 2 | - | - | 2 | 1 | 2 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Fluid Power Systems and Fundamentals**<br><br>Introduction to fluid power, Advantages of fluid power, Application of fluid power systems, Properties of hydraulic fluids, General types of fluids, Fluid power symbols, Basics of Hydraulics, Application of Pascal laws- Laminar and turbulent flow, Reynolds Number, Darcy equation, Losses in pipe, valves, and fittings | 04 |
| | **Hydraulic System and Components**<br><br>Sources of hydraulic power, pumping theory, Pump classification, Gear pump, vane pump, piston pump, construction and working of pumps, pump performance, variable displacement pumps, Fluid power actuators, Linear hydraulic actuators, Types of hydraulic cylinders: single acting, double acting, special cylinders like tanden, rodless, telescopic, cushioning mechanism, construction of double acting cylinder, Rotatory actuators, fluid motors, gear, vane and piston motors | 10 |
| | **Design of Hydraulic Circuits**<br><br>Construction of control components, directional control valve: 3/2 valve, 4/2 valve, shuttle valve, check valve, pressure control valve, pressure reducing valve, sequence | 10 |

| | | |
|---|---|---|
| | valve, flow control valves, fixed and adjustable, electrical control solenoid valve, relays, ladder diagram, accumulators, and intensifiers | |
| **Unit-2** | **Pneumatic Systems and Components**<br><br>Pneumatic Components, Properties of air, compressors, filter, regulator, lubricant unit, air control valves, quick exhaust valves, pneumatic actuators, fluid power circuit design, pneumo-hydraulic circuits, sequential circuits for simple applications | 12 |
| | **Design of Pneumatic Circuits**<br><br>Servo systems, hydro mechanical servo systems and proportional valves, Fluidics: Introduction to fluidic devices, simple circuits, Introduction to electrohydraulic pneumatic logic circuits, ladder diagrams, | 12 |

**Recommended Books-**


1. A Parr, *Hydraulics and Pneumatics: A technician's and engineer's guide*, 3rd edition, Butterworth-Heinemann, 2011.
2. H L.Stewart, *Practical Guide to Fluid Power*, 2nd edition, Audel, 1968.
3. K. S Sundaram, *Hydraulic And Pneumatic Controls (Understanding Made Easy)*, S.Chand, 2006
4. R. Srinivasan, *Pneumatic and Hydraulic control*,McGraw Hill Education, 2008.
5. S.R. Majumdar, *Pneumatic Systems: Principles and maintenance*, Tata Mcgraw Hill


**List of Practical's: IE-213**

1. Familiarization with pneumatic system's various parts such as compressor, regulator and lubricator.
2. To study 3/2 valve and 5/2 valve.
3. To study single acting and doubling acting cylinder and Flow restriction valve.
4. To study the Pneumatic Logic Circuit.
5. To study the use of Pneumatic Limit Switch.
6. To study the Hydraulic Trainer Kit.
7. To study the use of Hydraulic valve.
8. To study hydraulic system using single acting and double acting cylinder.
9. To study the practical application of Hydraulic system in stamping device.

## IE-214 Electrical and Instrumentation Drawing

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 0 | 0 | 4 | 2 | 4 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1**: **define** the fundamental concepts of electrical and Instrumentation Drawings.

**CO2: develop** the complete knowledge of rules involved in drawing the various layouts from scaling upto the complete electrical installations and electrical wiring.

**CO3: identify** and understand different Process flow diagrams.

**CO4: formulate** and solve the engineering problems of different Process flow diagrams.

**CO5: identify** different pneumatic and hydraulic components.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 |
| CO2 | 3 | 3 | - | 2 | 1 | - | 2 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 2 |
| CO4 | 3 | 3 | 1 | 2 | 2 | - | 2 |
| CO5 | 3 | 2 | - | 1 | 1 | 1 | 2 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Piping and Instrument Drawings and Instrument symbols**<br><br>General rules to be followed in drawing a flow sheets and symbols in a typical process industry, Meanings of functional instrumentation-identification letters, Relay function symbols, Interlock logicsymbols, Graphic symbols | 08 |
| | **Process Flow diagrams (PFD)**<br><br>PFDs of processes like power plant, fertilizer plants, cement plants etc. | 06 |
| | **Binary logic diagrams**<br><br>Symbols, flow diagrams, logic diagrams | 06 |
| Unit-2 | **Electrical drawings**<br><br>Electrical symbols, ground symbols, resistor, inductive and capacitor symbols, meter and power supply symbols, miscellaneous symbols | 08 |
| | **Panel wiring diagrams**<br><br>Symbols and wiring diagrams | 04 |

| | | |
|---|---|---|
| | **Pneumatic and hydraulic diagrams**<br><br>Basic symbols, pumps and compressor, motors, cylinders, control valves, control methods, check valves, exhaust valves etc. | 08 |

**Recommended Books-**

1. B G Liptak, *Instrument Handbook*, CRC Press, Vol.2
2. S K Bhattacharya, *Electrical Engineering Drawing*, New Edge International Publishers

## IE-215 Electromagnetic Energy Conversion

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: enumerate** the basic concept of electro-magnetic conversion device.

**CO2: explain** the construction and working principle of transformers and DC Machine

**CO3: describe** the working principle of Synchronous Machine and its characteristics

**CO4: explain** the working principle of Induction Machine and comparison with Synchronous Machine

**Pre-requisite Knowledge:** EE-111: Basic Electrical Engineering

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | 2 | - | 1 | 3 |
| CO2 | 3 | 3 | - | 2 | 1 | - | 2 |
| CO3 | 3 | 2 | 1 | - | 2 | 1 | 2 |
| CO4 | 3 | 3 | 1 | - | - | 1 | 2 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **INTRODUCTION**<br><br>Basic Principle, Types and constructional features of electrical machines, torque, torque angle, basic electromagnetic laws, Induced EMF. Review of electromagnetism, Magnetic field strength, Magnetic force. Energy stored in electric and magnetic fields, energy conversion in singly and multiple excited systems, reluctance torque, reluctance and hysteresis motors. | 08 |
| | **MAGNETIC CIRCUITS**<br><br>Magneto motive force, reluctance, laws of magnetic circuits, determination of ampere-turns for series and parallel magnetic circuits, magnetic leakage and fringing, hysteresis and eddy current losses. Faraday's laws, Lenz's law, statically and dynamically induced electromotive force (E.M.F)., Energy stored in magnetic field. | 08 |
| | **TRANSFORMERS**<br><br>Introduction, Principle of working, construction of single-phase transformer, EMF equation, phasor diagram on no-load, leakage reactance, transformer on load, equivalent circuit, voltage regulation, power and energy efficiency, open circuit and short circuit tests, equivalent circuit parameters estimation. Effect of saturation on exciting current, in-rush current phenomenon, Parallel operation of single phase | 08 |

| | | |
|---|---|---|
| | transformer. | |
| **Unit-2** | **D.C. MACHINE**<br><br>Construction of D.C. machines – theory of operation of D.C. generator – characteristics of D.C. generators – armature reaction – commutation – principle of operation of D.C. motor – voltage equation – type of D.C. motor and their characteristics – speed control of D.C. motors. | 10 |
| | **SYNCHRONOUS MACHINE**<br><br>Principle of alternators – construction details – equation of induced EMF – vector diagram – method of starting of synchronous motor – torque developed by the motor– V curves – speed control. | 08 |
| | **INDUCTION MACHINES**<br><br>Construction and principle of operation – classification of induction motor – relation between torque and rotor power factor – starting and running condition – condition for maximum torque – comparison between synchronous motor and induction motors<br>– speed control of induction motors. | 06 |

**Recommended Books-**


1. B. L. Theraja, *Electrical technology*, Vol I to II, S. Chand and Co., New Delhi
2. D P Kothari and I J Nagrath, *Electrical Machine*, TMH
3. E Hugh, *Electrical Technology,* Pearson Education.
4. M.G. Say, *Performance design and Testing of A.C. Machines*, 3rd edition, CBS Publisher, 2002.
5. MIT Department of Electrical Engineering, *Magnetic Circuits and Transformers: A First Course for Power and Communication Engineers Magnetic Circuits and Transformers*, MIT Press, 1977.


**List of Practical: IE-215**

1. Measurement of active and reactive power and phase-shift in AC circuits.
2. Series and parallel resonant circuits.
3. Measurement of time constants (RC/RL)
4. Verification of Network theorems (Superposition, Thevenin, Maximum power transfer)
5. Predetermination of efficiency and regulation of single-phase transformers
6. Load test on single phase/three phase transformers
7. Load characteristics of DC motors (shunt, series and compound)
8. Load characteristics of DC shunt/compound generators.
9. Load test on alternators
10. Synchronous motor characteristics
11. Load test on three phase induction motors
12. Load characteristics of a single phase induction motors.
13. House wiring and earthing.
14. Speed control of DC shunt motor using (a) armature control (b) field control
15. Swinburne's test

## IE-221 Human Physiology and Medical Instruments

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: describe** human body and blood compositions

**CO2: illustrate** working of cardiovascular, respiratory system and nervous system of human body

**CO3: interpret** the relation of electro-potential signals with human body

**CO4: explain** biomedical telemetry and its requirement

**CO5: enumerate** patient safety systems

**Pre-requisite Knowledge:** Biology XI and XII

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 2 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br><br>Human body, cells, Tissues, blood compositions, blood group red blood cell (RBC), white blood cell (WBC), Deoxyribonucleic Acid (DNA), GENES. | 04 |
| | **Cardiovascular and Respiratory system**<br><br>Introduction to Cardiovascular system, heart structure, electrocardiogram, flow of blood through heart, blood pressure. Lungs, types of respiration, measurement of respiration rate, ventilation, gas exchange, mechanism in lungs, lung volume capacities. | 12 |
| | **Nervous system**<br><br>Anatomy of nervous system, neurons, neural communication, brain, spinal cord. | 08 |
| Unit-2 | **Introduction** to Electrocardiography **(**ECG), Electroencephalography (EEG), electromyogram (EMG)**:** Physiological electrodes and transducers, origin of bioelectric signals; electrodes for ECG, EEG, EMG, skin contact Impedance,<br>conducting of electrode jellies and creams, electrocardiogram, electroencephalogram and electromyogram | 08 |

| | | |
|---|---|---|
| | **Patient Monitory Systems**<br><br>System concept; measurement of blood pressure, temperature, Pulse, respiration rate, ambulatory monitoring instruments, Application of computers in patient monitoring system, use of computers for processing cardio-topographic data. | 08 |
| | **Biomedical Telemetry and Patient Safety**<br><br>Concept of Telemetry, Advantages of Telemetry, Wireless Telemetry, single channel;analog physiological signals over telephone lines, Patient Safety:Electric shock hazards, leakage currents, patient isolation, safety measures. | 08 |

**Recommended Books- Text Book**

1. A.K Jain, Human Physiology, Arya Book Depot.
2. L Cromwell, Biomedical instrumentation and measurement, 2nd edition, Prentice Hall (India), 1990
3. RS Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw Hill, 2003.

**Reference Books**

1. Geddes and Baker, Principles of Applied Biomedical Instrumentation, Wiley.
2. N J Chinoi, Biomedical (for class XI and XII), NCERT.
3. Peter Strong, Physiological measurement**,** Prentice Hall.
4. Waugh and Grant, Anatomy and Physiology, Elsevier.

## IE-222 Maintenance and troubleshooting of Instruments

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 0 | 0 | 3 | 1 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1**: **identify** with basic tools and chemicals used for testing instruments.

**CO2: retell** different PCB fabrication materials and instruments. and know the.

**CO3: apply** the fabrication techniques for small project designs.

**CO4: generalize** sophisticated instruments and their testing and troubleshooting.

**Pre-requisite Knowledge:**

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | - | - | 1 | 1 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |

**List of Practicals: IE-222**

1. Use of Various hand tools for manufacturing and testing e.g. pliers, cutter, crimpers, stripper, screw driver etc.
2. Familiarization, use and practice of measuring instruments for testing and measurement e.g. Analog and Digital Multimeters, CRO, frequency meter, signal generators, signal sources, Inductance-Capacitance-Resistance (LCR) meter and IC tester.
3. Use of various chemicals used in instrumentation workshop and safety precautions to be observed.
4. Demonstration of various steps of printed circuit board (PCB) fabrication techniques:
   (i) Identification of PCB board materials, their characteristics, corrosion and its prevention
   (ii) Photo processing including photo print, etching, buffing, printing, high speed drilling, surface treatment, plated through holes, double sided PCBs.
   (iii) Assembly of circuits on PCB, soldering and de-soldering techniques, wire shaping, edge connectors.
5. Servicing and troubleshooting of Electrocardiography(ECG) equipment
6. Servicing and troubleshooting of Electroencephalography(EEG) equipment
7. Servicing and troubleshooting of electromyogram (EMG) equipment
8. Study of spirometers.
9. Testing Procedures of Resistance inductance and capacitors.

**Recommended Books-**

1. RS Khandpur, *Modern Electronic Equipment*, Tata McGraw Hill
2. KS Jamwal, *Maintenance of Electronic Equipment*, DhanpatRai and Sons
3. RS Khandpur, *Handbook of Biomedical Instrumentation*, Tata Mcgraw Hill.

## IE-223 Process Control

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: describe** the components used in process industries.

**CO 2: identify** different controller modes and their applications in different fields.

**CO 3: compare** different types of control schemes.

**CO 4: discuss** different types of control valves used for different processes.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | 1 | 1 | - | 3 |
| CO4 | 3 | 1 | 1 | 1 | 1 | 1 | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Basic Control Loops and Characteristics**<br><br>Introduction, resistance (R), inductance (L), capacitance (C) elements in pneumatic, hydraulic and electrical system; Simple Processes like: Single capacity pressure system, Single capacity temperature system, Single capacity level system, Single flow loop system, Computer control systems – Introduction to Supervisory digital control (SDC) and direct digital control (DDC) and their applications in process industries. | 12 |
| | **Basic Controller Modes and Characteristics**<br><br>Study of process characteristics; controller operating models, on-off, proportional, integral, derivative, proportional-integral, proportional-derivative, proportional- integral-derivative; relative merits of the above control modes; suitability of various control actions for different application | 12 |
| | **Multi-loop Controls**<br><br>Ratio, cascade, feed-forward control, Feedback Control, Various types of controllers – pneumatic, hydraulic, electronic, electro-hydraulic, digital. Study of transmitters-pneumatic, electronic, signal converters. | 12 |
| Unit-2 | **Annunciators**<br><br>Annunciators, Concept of sequencing, annunciation and interlocking applicable to process control systems. | 06 |

| | | |
|---|---|---|
| | **Control valves**<br><br>Globe, Ball, Gate, Needle, Diaphragm, Butterfly, Single seated and double seated valves, Selection criteria for control valves | 06 |

**Recommended Books-**

**Text Book**

1. D P EcKman, *Automatic Process Control,* TMH
2. S Bhanot, *Process Control, Principle and applications,* OXFORD

**Reference Books**

3. C D Johnson, *Process Control Instrumentation Technology,* Prentice Hall
4. P Harrist, *Process Control,* Prentice Hall
5. B G Liptak, *Instrument Engineers Handbook,* Wiley

**List of Practicals: IE-223**

1. Study of Pneumatic trainer kit (PTK) and demonstration of all components fabricated on kit.
   (a) Study of and gate and or gate on Pneumatic trainer kit
   (b) Study of single acting cylinder and double acting cylinder using 3/2 way valve and solenoid valve on PTK.
2. (a) Study of Hydraulic Trainer kit (HTK)
   (b) Study of single acting cylinder and double acting cylinder using hydraulic trainer
3. To study the calibration of the Electronic proportional-integral-derivative PID Controller.
4. To study the calibration of input/output (I/P) (Current to Pneumatic) converter
5. To study the calibration of Differential Pressure Transmitter
6. Study of Control Valve characteristics.
7. To study the tank level control loop (proportional-integral (PI) control)
8. To study the pressure control loop on Process Simulation kit
9. Study of feedback flow control loop. 10.Study of pressure transmitter.

11.Study of feedback temperature control system using proportional-integral (PI) controller. 12.Study of feedback temperature control system using proportional (P) controller.

13. Study of feedback temperature control system using proportional-integral-derivative (PID) controller.
14. Study of feedback temperature control system using PD controller

## IE-224 Analog and Digital Electronics

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 4 | 5 | 7 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: describe** integrated circuit (IC) and their advantages.

**CO2: illustrate** the working of operational amplifier (Op-amp), 555 timer, sequential logic concepts.

**CO3: interpret** the number system theory and various logic gate circuits.

**CO4: enumerate** the applications of different digital and analog components.

**CO5: illustrate** the working and applications of various Registers and Counters circuits

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br>Definition, Advantages of integrated circuits (ICs) over discrete components, Integration Types – small scale integration (SSI), medium scale integration(MSI), large scale integration(LSI), Classification- Monolithic and hybrid, Monolithic techniques, Monolithic components. | 04 |
| | **Operational Amplifier (Op-amp)**<br>Characteristics Ideal, inverting, non-inverting inputs virtual ground, Applications, Inverting, non-inverting amplifier | 08 |
| | **Op-amp Applications**<br>Comparator, Inverter, Adder, Subtractor, differentiator, integrator. | 08 |
| | **555 timer**<br>Simple Block Diagram, Pin configuration, 555 as a Mono stable and astable Multi-vibrator. | 04 |

| | | |
|---|---|---|
| **Unit-2** | **Number Systems and Boolean Algebra**<br><br>Number Systems And Boolean Algebra, Radix conversion, Subtraction using 1's and 2's complements, Binary codes, Canonical forms. | 06 |
| | **Combinational Logic**<br><br>Logic Gates, Definition and symbol, truth table and waveforms of NOT, AND, OR, NAND, NOR, XOR and XNOR, Universal Logic gates, Simplification using Karnaugh map. | 08 |
| | **Sequential Logic Concepts**<br><br>Flip flops: SR, JK, D and T flip-flops - Level triggering and edge triggering, Excitation tables | 06 |
| | **Registers and Counters**<br><br>Introduction and basic concepts including shift left and shift right, Serial in parallel out, serial in serial out, parallel in serial out, parallel in parallel out. Asynchronous and Synchronous Counters. Up Down Counter and Ripple Counter. | 08 |

**Recommended Books-**


1. A Kumar, *Fundamentals of Digital Circuits*, 3rd Edition, Prentice Hall of India, 2014.
2. A P Malvino, *Principles of DigitalElectronics*, 8th Edition, Tata McGraw Hill, 2015.
3. A. R Gayakwad, , *Op-Amps and Linear Integrated Circuits*. PHI Learning, 2009.
4. M M Mano, *Digital Logic and Computer Design*, 2nd Edition, Prentice Hall of India, 1991.
5. R J. Tocci, N S. Widmer and M L. Gregor, *Digital Systems: Principles and Applications*, 11th Edition, Prentice Hall of India, 2010.


**List of Practicals: IE-224**

1. To experimentally study the performance of inverting amplifier-using op-amp.
2. To experimentally study the performance of non-inverting amplifier using op-amp.
3. To experimentally study the performance of op-amp as integrator.
4. To demonstrate working of an op-amp as adder.
5. To demonstrate working of an op-amp as a subtractor.
6. To demonstrate working of an op-amp as a low pass filter.
7. Verification of the truth tables of transistor-transistor logic (TTL) gates.
8. Verify the NAND and NOR gates as universal logic gates.
9. Design and verification of the truth tables of Half and Full adder circuits.
10. Design and verification of the truth tables of Half and Full subtractor circuits.
11. Verify the truth table of a J-K flip-flop.
12. Design of 4 bit shift register

## IE-225 Mechanical Measurements-I

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 0 | 3 | 3 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: describe** the pressure, level, and flow measurement principles.

**CO 2: identify** different instruments used for the measurement of the different parameters.

**CO 3: classify** the instruments for different applications and understand their working.

**CO 4: differentiate** the studied techniques for different applications.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Mechanical Measurement**<br><br>Need of mechanical measurement, Basic definitions: Hysteresis, Linearity, Resolution of measuring instruments, Threshold, Drift, Zero stability, loading effect and system response. Measurement methods, Generalized Measurement system, Static performance characteristics, Errors and their classification. | 08 |
| | **Pressure measurement**<br><br>Pressure, vacuum, and head manometers, measuring elements for gage pressure and vacuum, measuring pressure in corrosive liquids, measuring of absolute pressure, static accuracy, and response of pressure gages. | 10 |
| | **Flow Measurement**<br><br>Head flow meters, open channel meters, area flow meters, flow of dry materials, viscosity measurement. | 06 |
| Unit-2 | **Level Measurement**<br><br>Direct measurement of liquid level, level measurement in pressure vessels, measurement of interface level, level of dry materials. | 06 |

| | | |
|---|---|---|
| | **Temperature Measurement**<br><br>Thermocouples, Resistance Temperature Detectors, Thermistor, Liquid in glass Thermometers, Pressure Thermometers, Pyrometer, Bimetallic strip, Industrial thermocouples, thermocouple wires, thermocouple wells and response of thermocouples. | 08 |
| | **Measurement of Force, Torque and Strain**<br><br>Force measurement: load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo-controlled dynamometer, absorption dynamometers. Power measurements. Measurement of strain: Mechanical strain gauges, electrical strain gauges, strain gauge: materials, gauge factors, theory of strain gauges and method of measurement, bridge arrangement, temperature compensation. | 10 |

**Recommended Books-**


1. B. G. Liptak, *Instrument Engineers' Handbook: Process Measurement and Analysis*
2. E. D. Doeblin, Measurement Systems: Application and Design, McGraw – Hill Publication
3. K. Krishnaswamy and S. Vijayachitra, *Industrial Instrumentation*, New Age International Publication

## IE-226 Electronic Measurements

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: explain** the basic electronic instruments and their working principle.
**CO 2: illustrate** the different blocks of some meters and CRO.
**CO 3: infer** the generation of different waveforms.
**CO 4: analyze** different types of waveforms using Signal Analyzers.
**CO 5: discuss** frequency measurement and their error analysis.

**Pre-requisite Knowledge:**

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Electronic analog meters**<br><br>Electronic analog meters: DC voltmeters- Loading- Transfer volt meter- Chopper type- DC amplifier voltmeter- Solid state voltmeter – Differential voltmeter – Peak responding voltmeter – True root mean square (RMS) voltmeter – Calibration of DC instrument | 08 |
| | **Digital voltmeter (DVM):**<br><br>Introduction – Ramp technique – Dual slope - Integrating type DVM –Successive approximations type DVM – Resolution and sensitivity of digital meters – General specifications of a DVM. | 08 |
| | **Cathode Ray Oscilloscope (CRO)**<br><br>Introduction, CRO block diagram, cathode ray tube (CRT) circuits, observation of waveform on CRO, Measurement of voltage, current, phase and frequency. | 08 |
| Unit- 2 | **Instruments for generation and analysis of waveforms**<br>Oscillators, classification of oscillators, Square wave and pulse generator, triangular wave shape generator, Signal generators, swept frequency generator, Frequency synthesizer. | 08 |
| | **Signal analyzers**<br><br>Wave analyser, harmonic distortion analyzer, spectrum analyzer, logic analyzer. | 08 |

| | | |
|---|---|---|
| | **High frequency measurement**<br><br>Frequency measurement, period measurement, errors in measurement, universal counters and extension of the range of counters | 08 |

**Recommended Books-**


1. E.W Golding and F.C Wides., *Electrical Measuring Instruments and Measurements,* Wheeler
2. H.S. Kalsi, *Electronic Instrumentation,* EXCEL BOOKS
3. S K Singh, *Industrial Instrumentation and control*, Second edition, TataMcgraw-Hill,NewDel
4. A K Sawhney, *A course in Electrical and Electronic Measurements and Instruments*, Dhanpatrai
5. A D Heltrick and W D Cooper , *Modern Electronic Instrumentation and Measuring Instruments*; Wheeler


**List of Practicals: IE-226**

1. Study of principle of operation of various types of electromechanical measuring instruments.
2. Measurement of resistance using Wheatstone Bridge.
3. Measurement of resistance using kelvin's Bridge.
4. Measurement of self inductance using Anderson's Bridge.
5. Measurement of capacitance using Schering Bridge.
6. Plotting of Hysteresis loop for a magnetic material using flux meter.
7. Measurement of frequency using Wein's Bridge.
8. To study the connections and use of Current and potential transformers and to find out ratio error.
9. Determination of frequency and phase angle using CRO.
10. Measurement of unknown voltage using potentiometer.
11. To find 'Q' of an inductance coil and verify its value using Q- meter.

## IE-311 Control Engineering

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: explain** the basic of Control systems, feedbacks and AC, DC servo motors.

**CO 2: solve** the steady state and transient analysis of a system for standard inputs**.**

**CO 3: compute** transfer function using block diagram reduction technique and mason's gain formula.

**CO 4: explain** frequency response and perform stability analysis in frequency domain.

**CO 5: analyze** the stability analysis of a system using root locus and zeros and poles

**Pre-requisite Knowledge:** Mathematics- I, Mathematics- II

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 2 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br><br>Introduction to control system – Basic components of control systems , open loop and closed loop control system, types of feedback control systems , transfer function , transfer function of electrical, mechanical and electromechanical systems . | 04 |
| | **Block diagram and Signal flow graphs**<br><br>Block diagrams of control systems, block diagram reduction, signal flow graph, Mason's gain formula, drawing signal flow graph from given block diagram. | 08 |
| | **Time domain Analysis**<br><br>Type and order of a system, typical test signals for the time response of control system, Unit step, unit ramp and unit impulse - response of first and second order systems , time domain specifications, steady state errors. | 10 |
| | **Poles, Zeros and stability**<br><br>Introduction, concepts of stability, absolute and relative stability, relationship of characteristic equation roots and stability, poles and zeros plots, Routh Hurwitz stability criterion, | 06 |

| | | |
|---|---|---|
| **Unit-2** | **Root Locus technique –**<br><br>Root Locus technique – basic theory and properties of root loci – procedure for construction of root loci, interpretation of the root locus diagrams. | 06 |
| | **Frequency response**<br><br>Frequency response, frequency domain specifications, frequency response for a first order and second order system, | 10 |
| | **Frequency domain analysis**<br><br>Frequency domain analysis techniques, Bode plot for transfer function, determination of gain margin, phase margin, ,Nyquist stability criterion. | 08 |
| | **Control system components**<br><br>Error detectors, DC and AC servo motors- Gyroscopes- Stepper motor, synchros, resolvers, Tacho-generators | 04 |

**Recommended Books-**


1. B C. Kuo, *Automatic Control System*, 8th edition, John Wiley and Sons, 2002.
2. J Nagrath and M Gopal, *Control System Engineering*, New Age, 2009.
3. K Ogata, *Modern Control Engineering*, 5th edition, Prentice Hall (PHI), 2010.


**List of Practicals: IE-311**

1. To study the operation of Temperature control system (Proportional controller).
2. To study the operation of D.C. Position Servomotor.
3. To study the operation of Temperature control system (Relay).
4. To control the Temperature of a system using P+I controller.
5. To control the Temperature of a system using P+I+D controller.
6. To study the time response of first order system.
7. To study the time response of second order system.
8. To study the operation of potentiometer error detector.
9. To study the A.C. servomotor and plot the torque. Vs. speed characteristics.

## IE-312 Analytical and Biomedical Instrumentation

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

After successful completion of course, the students should be able to
**CO1: explain** the basics of instrumentation related to biomedical systems.
**CO2**: **illustrate** the working of ECG, EMG and EEG.
**CO3: describe** imaging system and other medical equipments for diagnosis and therapy.
**CO4: enumerate** the importance of measurement using monitoring instrument and their applications.
**CO5: explain** the use of electromagnetic radiation in analytical instruments

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO5 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br><br>Fundamentals of Medical Instrumentation, Physiological electrodes and transducers, sensors for measurement of pressure, temperature, pulse, respiration, Introductions to pacemakers, defibrillators | 06 |
| | **Bioelectric Potentials and Recorders**<br><br>origin and characteristics of bioelectric signals; electrodes for Electrocardiography **(**ECG), Electroencephalography (EEG), electromyogram (EMG), electrocardiograph, phonon-cardiograph, electroencephalograph and electro-myograph, Electrical conductivity of electrode jellies and cream | 06 |
| | **Imaging Techniques**<br><br>X-Ray and digital radiography, computed tomography (CT) scan, Magnetic resonance imaging (MRI) , Ultrasonic and Thermal Imaging System | 06 |

| | | |
|---|---|---|
| | **Prosthetic and Monitoring Instruments**<br><br>dialysis machine, ventilator, respirators, Audiometers – basic audiometer, speech audiometer, Measurement of heart rate, pulse rate, blood pressure, temperature and respiration rate, Oximeters, Arrhythmia and Ambulatory monitoring Instruments | 10 |
| **Unit-2** | **Electromagnetic Radiation**<br>Electromagnetic Radiation And Spectrum, Interaction of Radiation With Matter, Beer's Lamberts Law, Radiation Sources | 04 |
| | **Spectrophotometer (ultraviolet (UV), Visible and infrared (IR))**<br>Basic principle , block diagram and related instrumentation | 06 |
| | **Analytical Instruments**<br><br>Blood Flow-meters – Electromagnetic ultrasonic. Pulmonary function Analyzer – measurement, spirometry analysis, respiratory gas analyzer. Blood Gas analyzers – Blood pH, Oxygen, PCO2, PO2 measurement complete blood gas analyzer, cell counter. | 14 |

**RECOMMENDED BOOKS:**

**Text Book:**

1. RS Khandpur, *Handbook of Biomedical Instrumentation*, TMH, 2003

**Reference Books:**

1. L Chromwell, *Biomedical Instrumentation*, Prentice Hall,2$^{ND}$ edition,2009
2. L A Geddes and L E Baker, *Principles of Applied Biomedical Instrumentation*, Wiley and sons, 1975
3. P Strong, *Physiological measurement***,** Prentice Hall, 1970

**List of Practicals: IE-312**

1. To measure the respiration rate of human body with the help of Thermistor as a transducer.
2. To measure the pulse rate of human body with the help of physiopac.
3. To measure the GSR of human body using Biofeed back kit.
4. To measure the blood pressure using sphygmomanometer and Stethoscope.
5. To measure the blood pressure using OMRON kit.
6. To study the Blood sugar device.
7. To study the characteristics of ECG signal.
8. To Study the characteristics of EEG signal.
9. To measure the transmittance of a given sample solution using UV spectrometer.
10. To measure the transmittance of a given sample solution using Visible spectrometer
11. To measure the concentration of a given sample solution using UV spectrometer.
12. To measure the concentration of a given sample solution using Visible spectrometer

## IE-313 Data Acquisition Systems

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

After successful completion of course, the students should be able to
**CO1: explain** the basics of data acquisition system.
**CO2**: **describe** how data is to be transmitted through different techniques**.**
**CO3: illustrate** the working principle of data converters and data recorders.
**CO4: enumerate** the applications of various data acquisition systems.
**CO5: list** the importance of measurement and monitoring using instrument.

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 2 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outline | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br>General concept, Importance of data acquisition system (DAS) to instrumentation Types of DAS components of Analog data acquisition system, Digital data acquisition system, Use of data acquisition system, Use of Data Acquisition system | 08 |
| | **Signal Conditioning**<br>Signal conditioning of inputs, single channel and multichannel data acquisition, computer based DAS. | 08 |
| | **Data Transmission-I**<br>Multiplexing and Demultiplexing, introduction to modulation and demodulation, Analog and Digital Modulation techniques, | 08 |
| Unit-2 | **Data Transmission-II**<br>Pulse code formats used in data transmission, Frequency division and time division multiplexing, time division multiplexing using mechanical commutator, Electronic time division multiplexing, | 08 |
| | **Converters**<br>Digital to Analog Converters (DAC), Analog to Digital Converters (ADC), Electromechanical ADC, Digital Transducer | 08 |

| | | |
|---|---|---|
| | **Recorders**<br><br>Working principle, construction, operation and salient features of X-T strip chart recorder, X-Y strip chart recorder and magnetic recorder | 08 |

**Recommended Books-**


1. A K Sawhney, "*Electrical and Electronic Measurement and Instrumentation*", DhanpatRai and Sons, 1993
2. E O Doebelin , "*Measurements Systems- Application and Design*", Tata McGraw Hill,1975
3. H S Kalsi, "*Electronic Instrumentation*", Tata McGraw Hill,2004
4. A M Ruiz and H Vromans, "*Data Acquisition and Measurement Techniques*", CRC Press,1998


**List of Practicals: IE-313**

1. To construct weighted Resistance type of Digital to Analog converter
2. Study of Time-division multiplexing (TDM) Pulse Amplitude Modulation/Demodulation with Transmitter clock and channel identification information linked directly to the Receiver.
3. Study the effect of reconstructed wave form by the use of Sample/Hold circuit.
4. To study the Pulse Code Modulation.
5. To construct and study the Butterworth first order low pass filter.
6. To construct and study the Butterworth first order high pass filter with given cut off frequency.
7. To study the second order low pass active filter.
8. To study the second order high pass active filter.
9. To construct and study the all pass filter.
10. To construct and study the Band pass filter.
11. To construct the circuit for summer and differentiator using operational amplifiers.
12. To construct the circuit for integrator and differentiator using operational amplifiers.
13. To construct the circuit for Voltage to Current converter and Current to Voltage converter using operational amplifiers.
14. To study the digital half adder circuits.
15. To study the digital full adder circuits.

## IE-314Mechanical Measurements-II

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: recall** the theoretical and practical aspects of measurement.

**CO 2: identify** different instruments used for the measurement of the different parameters.

**CO 3: classify** the instruments for different applications and understand their working.

**CO 4: differentiate** the studied techniques for different applications and apply them.

**CO 5: modify** and develop some advanced technique for mechanical measurement.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 2 | 1 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |

**Theory:**

| Unit | Main TopicsCourse Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Metrology**<br><br>Definition of metrology-Linear measuring instruments: Vernier, micrometer, Slip gauges, and classification, - Tool Makers Microscope - interferometery, optical flats, Comparators: limit gauges Mechanical, pneumatic and electrical comparators, applications. Angular measurements: -Sine bar, Sine center, bevel protractor and angle Decker | 08 |
| | **Force and Torque**<br><br>Electric balance– different types of load cells– magnets– elastics load cell-strain gauge load cell-different methods of torque measurement, strain gauge, relative regular twist-speed measurement-revaluation counter- capacitive tacho-drag up | |
| | **Measurement of acceleration, vibration**<br><br>Accelerometers– linear variable differential transformer (LVDT), piezo-electric, strain gauge and variable reluctance type accelerometers– mechanical type vibration instruments– seismic instrument as an accelerometer and vibrometer– calibration of vibration pick ups | 08 |

| | | |
|---|---|---|
| | **Density, and pH measurement**<br><br>units of density, specific gravity and viscosity used in industries– Baume scale API scale– pressure head type densitometer– float type densitometer– ultrasonic densitometer Bridge type gas densitometer, pH measurement techniques | 06 |
| | **Measurement of viscosity, humidity and moisture**<br><br>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. | 10 |

**Recommended Books-**


1. R KJain, "*Engineering Metrology*", Khanna Publishers, 2005
2. D Patranabis, *Principles of Industrial Instrumentation*, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
3. A K Sawhney and PuneetSawhney, A course on electrical and electronic measurements and instrumentation, DhanpatRai, 2012.
4. P Holman, *Experimental Methods for Engineers*, International Student Edition, McGraw Hill Book Company, 1971.
5. B C Nakra and K K Chaudary, *Instrumentation Measurement and Analysis*, McGraw Hill Publishing Company Ltd., New Delhi, 1985.
6. R K Jain, "*Engineering Metrology*", Khanna Publishers, 2005


**List of Practicals: IE-314**

1. Measurement of thickness using vernier,slip gauge
2. Angular measurement using sine bar, sine centre
3. Force measurement using load cells
4. Strain measurement using strain gauges
5. Torque measurement using stroboscope
6. Measurement of acceleration using LVDT, piezo-electric methods
7. Measurement of pH
8. Measurement of density
9. Measurement of viscosity
10. Measurement of humidity

## IE-315 Microprocessors and Microcontrollers

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1: illustrate** 8085 microprocessor internal architecture, timing diagrams and interrupts.

**CO 2: group** instruction format of 8085 microprocessor, addressing modes and program development tools.

**CO 3: rewrite** programming loop structure with counting and indexing for 8085 microprocessors.

**CO 4: reproduce** the architecture of 8051microcontroller, its special registers and port operation.

**CO 5: simulate** the programs of 8051 microcontroller using different instructions**.**

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | - | - | 1 | 1 | 2 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 3 | - | 1 | 1 | 1 | - | 3 |
| CO5 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **8085 microprocessor**<br><br>Hardware Architecture pintouts - Signals – Memory interfacing – input/output (I/O) ports and data transfer concepts, Timing Diagram, Interrupt structure. | 12 |
| | **PROGRAMMING OF 8085 PROCESSOR**<br><br>Instruction format and addressing modes – Assembly language format – Data transfer, data manipulation and control instructions – Programming: Loop structure with counting and Indexing – Look up table - Subroutine instructions - stack. | 12 |
| Unit-2 | **Microcontroller 8051 hardware and architecture**<br><br>Introduction to 8051 microcontroller, Architecture and Memory Organization, Special function registers, Port operations | 12 |
| | **Programming of 8051 microcontroller**<br><br>Programming model of 8051, operand types, operand addressing, Data transfer instructions, Arithmetic Instructions, Logic Instructions, Control transfer instructions, Programming | 12 |

**Recommended Books-**

1. B Ram., Fundamentals of Microprocessors and Microcomputers. DhanpatRaiand Sons, 1998.
2. D V Hall, Microprocessors and interfacing: Programming and Hardware, Tata McGraw Hill, 2007.
3. R S Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085, Penram International.
4. A K Ray and K M Bhurchandi, Advanced Microprocessors and Peripherals, Tata McGraw Hill (Ed.), Prentice Hall, 1997.

## IE-321 Elements of Computer Programming

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 2 | 0 | 2 | 3 | 4 |

**Course Outcomes:**

After successful completion of course, the students should be able to
**CO1: explain** steps in development of a program, flow chart and debugging.
**CO2: rewrite** program structure, input/output function and control statements.
**CO3: apply** pointers, array, and function in a programming.
**CO4: simulate** simple programs to understand the program development.

**Pre-requisite Knowledge:** Nil

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | - | - | 2 | - | - | 2 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Algorithms and Program Development**<br><br>Steps in development of a program, Flow Chart, Algorithm Development, Program debugging. | 04 |
| | **Program Structure**<br><br>Data types,Input/Output statements, assignment statements; variables; arithmetic logical and relational operators – their precedence. logical and relational operators, standard input/output (I/O) functions, formatted input/ output (I/O). Input/ output using files. | 08 |
| | **Control Statements**<br><br>for statement, if-then-else, while, do-while, break, switch statements. | 04 |
| Unit-2 | **Functions and Arrays**<br><br>Function declaration, parameters, parameter passing, call-by-value, call-by- reference, storage classes (local, global and static variables), function prototype, Single and multi-dimensional arrays, character arrays. | 08 |
| | **Pointers**<br><br>Introduction to Pointers and Pointers to various data types. | 04 |
| | **Introduction to Structures**<br><br>Definition of a structure, pointers to structures, union, arrays of structures. | 04 |

**Recommended Books-**


1. E Balaguruswamy, *Programming in ANSI C*, 6th edition, Mcgraw Hill Education, 2012.
2. J R Hubbard**,** *Schaum's Outline of Programming with C++*, Schaum's Outline Series, 2000.
3. R Subburaj, *Programming in C*, 1st edition, Vikas Publishing, New Delhi, 2000.


**List of Practical: IE-321**

1. WAP that accepts the marks of 5 subjects and finds the sum and percentage marks obtained by the student.
2. WAP that calculates the Simple Interest and Compound Interest. The Principal, Amount, Rate of Interest and Time are entered through the keyboard.
3. WAP to calculate the area and circumference of a circle.
4. WAP that accepts the temperature in Centigrade and converts into Fahrenheit using the formula C/5= (F-32)/9.
5. WAP that swaps values of two variables using a third variable.
6. WAP that checks whether the two numbers entered by the user are equal or not.
7. WAP to find the greatest of three numbers.
8. WAP that finds whether a given number is even or odd.
9. WAP that tells whether a given year is a leap year or not.
10. WAP that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
    Between 90-100% ---------- Print 'A'
    80-90% ..... Print 'B'
    60-80% ---------- Print 'C' Below 60% Print 'D'
11. WAP that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
12. WAP to print the sum of all numbers upto a given number.
13. WAP to find the factorial of a given number.
14. WAP to print sum of even and odd numbers from 1 to N numbers.
15. WAP to print the Fibonacci series.
16. WAP to check whether the entered number is prime or not.
17. WAP to find the sum of digits of the entered number.
18. WAP to find the reverse of a number.
19. WAP to print Armstrong numbers from 1 to 100.
20. WAP to convert binary number into decimal number and vice versa.
21. WAP that simply takes elements of the array from the user and finds the sum of these elements.
22. WAP that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
23. WAP to find the minimum and maximum element of the array.
24. WAP to search an element in a array using Linear Search.
25. WAP to sort the elements of the array in ascending order using Bubble Sort technique.
26. WAP to add and multiply two matrices of order n x n.
27. WAP that finds the sum of diagonal elements of amxn matrix.
28. WAP to implement strlen (), strcat (), strcpy () using the concept of Functions.

## IE-322 Case Study of Process Plants

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: describe** the working of different types of process equipments used in process plants.

**CO2: relate** the block diagram, and controllers P, I and D to different process plants.

**CO3: compare** the process of different types of plants.

**CO4: explain** the instrumentation and control used in different types of plants.

**Pre-requisite Knowledge:** IE-225 and IE-314, Mechanical Measurements

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO3 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br><br>Study of different types of Distillation columns, Boilers, Chillers, Reactors, Heat Exchangers, Compressors etc. | 06 |
| | **Boiler**<br><br>Steam generators Steam generator – Application - Modern high-pressure boiler - La-Mont boiler, Benson boiler – Boiler piping and insulation. Draught-natural - forced - induced - balanced | 06 |
| | **Condenser**<br><br>Steam Condensers Introduction - functions -Types - Jet condensers - counter flow and parallel flow type- Surface condensers –Condenser efficiency-Vacuum efficiency – definition- Factors affecting the vacuum efficiency-Mass of cooling water requirement -Cooling tower - function - types-Mass flow rate of water – Simple Problems. | 06 |
| Unit-2 | **Hydro Power Plant**<br><br>Hydro Power Station Energy conversion process for hydro-power station (HPS) with plant layout Selection of site for HPS Classification of HPS: based on head, Storage and pondage type, Plant Layout, types of water turbines Auxiliaries of HPS Major features of HPS Hydro power stations in Punjab | 06 |

| | | |
|---|---|---|
| | **Solar power plant**<br><br>Solar Power Plant Solar constants, Measurement of solar radiations Solar Energy Conversion CSP generators, construction and working principal construction of a solar PV Systems: Solar cell, Module, Panel, and array Types of solar PV system i. Stand – Alone Solar PV system ii. Grid-Interactive solar PV system iii. Hybrid Solar PV system Grid connection issues of solar power plants Solar power plants in Punjab. | 08 |
| | **Petrochemical plants**<br><br>Overview of drilling, Fundamentals of Well Logging Techniques, Well equipments, Petroleum Transportation and storage System. | 08 |
| | **Instrumentation of other Plants**<br><br>Study of Processes, Block Diagram, flow diagram, Instrumentation and control of Cement Plant, Sugar Plant, Fertilizer Plant, Paper and Pulp Plant, Food Industries etc. | 08 |

**Recommended Books- Text Book**

1. D Prasad, *Instrumentation and Control System*, AICTE Continuity Education Program
2. G N Pandey, A Textbook of Chemical Technology,vol I and II, Vikas Publishing House
3. W G Andrew, H B Williams, *Applied Instrumentation in the Process Industries: Engineering Data and Resource*, 3rd edition, Gulf Publishing Co, 1993.

**Reference Books**

1. B G Liptak, Process Control: Instrument Engineers' Handbook, 3rd edition, Butterworth Heinemann, 1995.
2. G K Mcmillan, D M Considine, Process/Industrial Instruments and Controls Handbook, 5th edition, McGraw-Hill Professional, 1999.

**List of Practical: IE-322**

1. Study of Distillation column.
2. Study of Boiler.
3. Study of Chiller.
4. Study of Reactor.
5. Study of Heat Exchanger.
6. Study of Compressor.
7. Flow chart of Hydro Power Plant.
8. Flow chart of Cement Plant.
9. Flow chart of Sugar Plant.
10. Flow chart of Fertilizer Plant
11. Flow chart of Paper plant.
12. Flow chart of Pulp Plant.
13. Flow chart of Food Industry.
14. Flow chart of chemical industry.

## IE-323 Industrial Automation and Safety

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO1: explain** the basics of PLC architecture and PLC programming.

**CO 2: rewrite** a PLC program for an automatic control system of a medium degree of complexity.

**CO 3: illustrate** the different parts of distributed control system.

**CO 4: discuss** automation system as network communication and safety and protection against interference.

**Pre-requisite Knowledge:**

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 2 | 2 | 1 | 1 | 1 | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory:**

| Unit | Main Topics and Course Outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction to Programmable Logic Controllers (PLC)**<br><br>Advantages and disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC. | 06 |
| | **PLC programming methodologies:**<br><br>Ladder diagram, Statement List (STL), functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC. | 10 |
| | **PLC functions:**<br><br>Bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer and Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics. | 08 |
| Unit- 2 | **Distributed Control System (DCS)**<br><br>Evolution of DCS, Architecture of DCS, Direct Digital Control, Hierarchical structure, different functional levels, database organization for DCS, data communication link, reliability and consideration in DCS, flow sheet symbols. | 12 |

| | | |
|---|---|---|
| | **Area classification and Intrinsic Safety**<br><br>Hazardous Area definitions, Protection methods, NEMA enclosures, Ingress Protection, Purging and intrinsic safety. | 12 |

**Recommended Books-**


1. B G Liptak, *Instrumentation Engineering Handboo*k, Chilton Book Company
2. W G Andrews: *Applied Instrumentation in Process Industries (Volume II and III)*
3. E O Doeblin: *Measurement Systems: Application and Design*, TMH
4. R K Jain: *Mechanical and Industrial Measurements*, Khanna Publishers


**List of Practicals: IE-323**

1. To study Ladder logic programming of a industrial PLC like SEIMENS/FATEK/MICROLOGIX
2. To write programme for control of Drinks machine,.
3. To write a Programme for Car Parking.
4. To study step step sequence in a PLC
5. To write a programme and interface simulated hardware unit of Tank level control.
6. To write a programme and interfaceand control a traffic light using PLC.
7. To write a programme and interface and control a simulated elevator control using PLC
8. To write a programme and interface and control a conveyer belt using PLC
9. To write a programme and interface and control speed of a DC motor using PLC
10. To write a programme and interfaceand temperature control system using analog outputs of a PLC.

## IE-324 Power Electronics and Drives

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 3 | 0 | 2 | 4 | 5 |

**Course Outcomes:**

After successful completion of course, the students should be able to

**CO 1: describe** power semiconductor devices, their properties, and characteristics.

**CO 2: illustrate** the principle of AC-DC, DC-DC, DC-AC conversion circuits and their applications.

**CO 3: explain** of sinusoidal analysis of resonant converters and its applications.

**CO 4: compare** concept of inverters which consist of half and full bridge, single and three phase etc.

**CO 5: infer** electric drive and power quality problems generated by various electric drives.

CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation):

| COs | Programme Outcomes (POs) | | | | | | |
|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 2 | 1 | - | 1 | - | 3 |
| CO5 | 3 | 2 | 1 | 1 | 1 | - | 3 |

**Theory:**

| Unit | Main Topics andCourse outlines | Hour(s) |
|---|---|---|
| Unit-1 | **Power Semiconductor Devices**<br><br>Thyristor (silicon controlled rectifier (SCR)), their Symbol, Construction and Operation, voltage-current (V-I) Characteristics, Thyristor Turn on and Turn off (commutation) methods; Thyristor Specifications and Ratings; thyristor protection circuits; Heat Sinks and Mountings, Thyristor Family and other power semi- conductor devices: Symbols and V-I Characteristics. | 06 |
| | **Converters**<br><br>Converters : Un-controlled and controlled, Half wave and Full wave, Half controlled and full controlled, Single Phase and three phase, with Resistive Load and RL Load, with and without Freewheeling Diode, Comparison of 3 phase and single phase Converters, Effect of Source Impedance on Converter Operation; Cyclo-converters: Single phase and three phase, principle of operation, Input output waveforms. | 09 |
| | **Inverters**<br><br>Classification of Inverters: Voltage source and current source, single phase and three phase, Half Bridge and Full Bridge; Line Commutated and Forced Commutated; Series and Parallel; Operation of these inverters; Voltage and Frequency Control of single phaseInverters, Pulse Width Modulation(PWM) controlled Inverters, Waveform Control (Harmonic Reduction) of Inverters | 09 |

| | | |
|---|---|---|
| **Unit-2** | **DC-DC Converters**<br><br>Converter Classification: Buck, Boost and Buck-Boost, Isolated and non isolated topologies, single switch, two and four switches topologies; their operation and applications | 06 |
| | **Choppers**<br><br>Chopper Principle, Control Techniques: Constant Frequency and Variable Frequency; Classification of Choppers: Class A, Class B, Class C, Class D and Class E; Commutations Methods for Choppers | 08 |
| | **Applications to Industrial Systems**<br><br>DC Drives: Open loop and closed loop control schemes for Speed and torque control of DC motors, various topologies for these controls; AC Drives: Speed and torque control of three phase Induction Motor; Open/Closed loop control of stepper motor, AC/DC servomotor, and other special motors; Other Applications: Induction Heating Control, Electric Welding Control, Battery Charging Control, Static VAR Compensation System. | 10 |

**Recommended Books:**


1. G K Dubey, *Power semiconductor drives,*Prentice Hall Inc,1989
2. F D Petruzella, *Industrial Electronics,* , McGraw- Hill,1995
3. N M Morris, *Industrial Electronics*, McGraw-Hill,London 1984
4. M D Singh and K B Khanchandani, *Power Electronics*, 2nd Edition, TMH,2001


**List of Practicals: IE-324**

1. To identify the terminals and plot V-I Characteristics of Thyristor.
2. To identify the terminals and plot V-I Characteristics of Diac.
3. To identify the terminals and plot V-I Characteristics of Triac.
4. To study various turn on methods of Thyristor.
5. To study the waveforms of a single phase Full Wave converter Using Thyristor.
6. To study the waveforms of a single phase Half controlled Bridge converter Using Thyristor.
7. To study the waveforms of a single phase full controlled Bridge converter Using Thyristor.
8. To study the waveforms of a three phase half controlled Bridge converter Using Thyristor.
9. To study the waveforms of a three phase full controlled Bridge converter Using Thyristor.
10. To study the waveforms of a single phase Bridge inverter.
11. To study the waveforms of DC-DC converter in buck/boost mode.
12. To Perform Speed control of DC shunt motor by voltage control using single phase half/full controlled converter.
13. To perform speed control of three phase Induction motor using Rectifier and PWM Inverter.
14. To Perform speed control of any special machine using Rectifier and PWM Inverter.

## IE-325 Telemetry and Display Devices

| L | T | P | Credits | Weekly Load |
|---|---|---|---|---|
| 2 | 0 | 0 | 2 | 2 |

After successful completion of course, the students should be able to

**CO1: discuss** the basics of Data transmission methods.

**CO2**: **explain** general telemetry system and transmission channels considering their impact in global context.

**CO3: describe** how data is to be transmitted through different techniques like TDM and FDM.

**CO4: explain** basics of display devices and recognize their need in life.

| CO/PO Mapping : (Strong(1) / Medium(2) / Weak(3) indicates strength of correlation): | | | | | | | |
|---|---|---|---|---|---|---|---|
| COs | Programme Outcomes (POs) | | | | | | |
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 |
| CO1 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO2 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO3 | 3 | 1 | 1 | - | 1 | - | 3 |
| CO4 | 3 | 1 | 1 | - | 1 | - | 3 |

**Theory**

| Unit | Main Topics and Course Outline | Hour(s) |
|---|---|---|
| Unit-1 | **Introduction**<br>Introduction to data transmission, methods of data transmission-Hydraulic, Pneumatic, Electrical or Electronic | 06 |
| | **Types of Telemetry**<br>Definition of telemetry, General requirements of telemetry system, Types of telemetry-Voltage Telemetry, Current Telemetry and Position Telemetry | 06 |
| | **Data Transmission**<br>A. C. Telemetry and Concept of Digital telemetry- Pulse code modulation (PCM), Delta Modulation (Basic Principle (Only) | 06 |
| Unit-2 | **Transmission Channel and Media**<br>wire line channels, Radio channels, Microwave channels, Power line carrier channel and optical fibre channels | 04 |
| | **Multiplexing and Demultiplexing**<br>Time division multiplexing (TDM) and frequency division multiplexing (FDM), Concept of CDMA (Code Division Multiple Access). | 06 |
| | **Display Devices**<br>Construction, principle of operation and salient features of various kinds of display devices-light-emitting diode (LED), Nixie tube,liquid crystal display(LCD), segmental gas discharge type, optical displays | 08 |

**Recommended Books-**


1. A K Sawhney, "*Electrical and Electronic Measurement and Instrumentation*", DhanpatRai and Sons, 1993
2. D Patranabis, "*Telemetry Principles*", Tata McGraw Hill,2007
3. E O Doebelin, "*Measurements Systems- Application and Design*", Tata McGraw Hill,1975
4. E L Gruenberg, "*Handbook of Telemetry and Remote Control*", Tata McGraw Hill,1967
5. H S Kalsi, "*Electronic Instrumentation*", Tata McGraw Hill,2004
6. A R Munez and H Vromans, "*Data Acquisition and Measurement Techniques*", CRC Press, 1998.