

## STATE COUNCIL FOR TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA

**TEACHING AND EVALUATION SCHEME FOR 4th Semester Electrical (Instrumentation and Control)(wef 2019-20)**

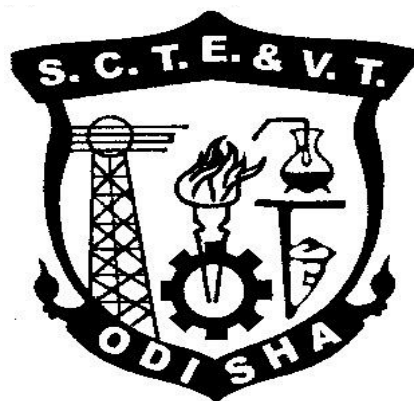
| Subject Number                                                                                                                                                                                                                           | Subject Code | Subject                                   | Periods/week  |           |           | Evaluation Scheme              |               |               |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------------------------|---------------|-----------|-----------|--------------------------------|---------------|---------------|------------|
|                                                                                                                                                                                                                                          |              |                                           | L             | T         | P         | Internal Assessment/ Sessional | End Sem Exams | Exams (Hours) | Total      |
|                                                                                                                                                                                                                                          |              |                                           | <b>Theory</b> |           |           |                                |               |               |            |
| Th.1                                                                                                                                                                                                                                     |              | Electrical Machine*                       | 4             | 1         |           | 20                             | 80            | 3             | 100        |
| Th.2                                                                                                                                                                                                                                     |              | Analog Electronics & OP-Amp*              | 4             | 1         |           | 20                             | 80            | 3             | 100        |
| Th.3                                                                                                                                                                                                                                     |              | Electrical Measurement & Instrumentation* | 4             | 1         |           | 20                             | 80            | 3             | 100        |
| Th.4                                                                                                                                                                                                                                     |              | Generation, Transmission & Distribution*  | 4             | 1         |           | 20                             | 80            | 3             | 100        |
|                                                                                                                                                                                                                                          |              | <i>Total</i>                              | <i>16</i>     | <i>04</i> |           | <i>80</i>                      | <i>320</i>    | <i>-</i>      | <i>400</i> |
|                                                                                                                                                                                                                                          |              | <b>Practical</b>                          |               |           |           |                                |               |               |            |
| Pr.1                                                                                                                                                                                                                                     |              | Electrical Machine Lab                    |               |           | 6         | 25                             | 100           | 4             | 125        |
| Pr.2                                                                                                                                                                                                                                     |              | Analog Electronics Lab                    |               |           | 6         | 25                             | 100           | 4             | 125        |
| Pr.3                                                                                                                                                                                                                                     |              | Simulation Practice on MATLAB             |               |           | 4         | 50                             | 50            | 4             | 100        |
|                                                                                                                                                                                                                                          |              | Student Centered Activities(SCA)          |               | -         | 3         |                                |               |               |            |
|                                                                                                                                                                                                                                          |              | <i>Total</i>                              | <i>-</i>      | <i>-</i>  | <i>19</i> | <i>100</i>                     | <i>250</i>    | <i>-</i>      | <i>350</i> |
|                                                                                                                                                                                                                                          |              | <b>Grand Total</b>                        | <b>16</b>     | <b>04</b> | <b>19</b> | <b>180</b>                     | <b>570</b>    | <b>-</b>      | <b>750</b> |
| Abbreviations: L-Lecturer, T-Tutorial, P-Practical . Each class is of minimum 55 minutes duration                                                                                                                                        |              |                                           |               |           |           |                                |               |               |            |
| Minimum Pass Mark in each Theory subject is 35% and in each Practical subject is 50% and in Aggregate is 40%                                                                                                                             |              |                                           |               |           |           |                                |               |               |            |
| SCA shall comprise of Extension Lectures/ Personality Development/ Environmental issues /Quiz /Hobbies/ Field visits/ cultural activities/Library studies/Classes on MOOCS/SWAYAM etc. ,Seminar and SCA shall be conducted in a section. |              |                                           |               |           |           |                                |               |               |            |
| There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester                               |              |                                           |               |           |           |                                |               |               |            |

# **CURRICULLUM OF 4<sup>TH</sup> SEMESTER**

**For**

## **DIPLOMA IN ELECTRICAL (Instrumentation & Control) ENGINEERING**

**(Effective FROM 2019-20 Sessions)**



**STATE COUNCIL FOR TECHNICAL  
EDUCATION & VOCATIONAL TRAINING,  
ODISHA, BHUBANESWAR**

## Th1. ELECTRICAL MACHINE

|                                                                                    |          |                           |                 |
|------------------------------------------------------------------------------------|----------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (Instrumentation and Control)Engineering |          |                           |                 |
| Course code:                                                                       |          | Semester                  | 4 <sup>th</sup> |
| Total Period:                                                                      | 60L+ 15T | Examination               | 3 hrs           |
| Theory periods:                                                                    | 5P/week  | IA Test:                  | 20              |
| Maximum marks:                                                                     | 100      | End Semester Examination: | 80              |

### A. RATIONALE:

The application of Rotary and Static Electrical machines find extensive use in modern industries is still in practice. The Electrical machine subject is intended to provide insight the concept of different Electrical Machines with their operation and control. This subject also deals with the fundamental concept of single phase and three phase AC machines.

### B. OBJECTIVE:

After Completion of the Subject students will be able to:

1. Understand property & use of Electrical conducting & insulating materials.
2. Explain working principle & construction of DC generator.
3. Explain construction & working principle of motor & speed control of DC motor.
4. Discuss AC fundamentals.
5. Explain Construction & principle of transformer.
6. Describe principle of working of three-phase Induction motor.
7. Describe principle of single-phase motor.

### C. TOPIC WISE DISTRIBUTION OF PERIODS:

| Sl. No.      | Topic                        | Periods   |
|--------------|------------------------------|-----------|
| 1.           | Electrical material          | 04        |
| 2.           | DC generator                 | 10        |
| 3.           | DC motor                     | 08        |
| 4.           | Ac circuits                  | 08        |
| 5.           | Three phase supply           | 04        |
| 6.           | Transformer                  | 08        |
| 7.           | Induction motor              | 10        |
| 8.           | Single phase induction motor | 05        |
| 9.           | Alternator                   | 03        |
| <b>TOTAL</b> |                              | <b>60</b> |

### D. COURSE CONTENT:

#### 1. ELECTRICAL MATERIAL:

- 1.1. Properties & uses of different conducting material.
- 1.2. Properties & use of various insulating materials used electrical engineering.
- 1.3. Types of Magnetic materials & their uses.

## 2. DC GENERATOR:

- 2.1. Basic working principle, constructional feature of DC Generator.
- 2.2. Classification of DC generator with voltage equation.
- 2.3. Derivation of EMF equation & simple problems.
- 2.4. Applications of DC generators.
- 2.5. Parallel operation of DC generators.

## 3. DC MOTOR:

- 3.1. Working Principle of a DC motor.
- 3.2. Concept of development of torque & back EMF in DC motor. (simple problems)
- 3.3. Derive equation relating to back EMF, Current, Speed and Torque equation.
- 3.4. Classification of DC motors & their characteristics
- 3.5. Application of DC motors.
- 3.6. State & explain three point & four point stator of DC motor.
- 3.7. Speed control of DC motor by field control and armature voltage control method.
- 3.8. Explain power stages of DC motor & derive Efficiency of a DC motor.

## 4. AC CIRCUITS:

- 4.1. State Mathematical representation of phasors, significant of operator "j".
- 4.2. Addition, Subtraction, Multiplication and Division of phasor quantities.
- 4.3. Explain AC series circuits containing resistance, capacitances, Concept of active, reactive and apparent power and Q-factor of series circuits. (Solve related problems)
- 4.4. Find the relation of AC Parallel circuits containing Resistances, Inductance and Capacitances Q-factor of parallel circuits

## 5. THREE PHASE SUPPLY:

5. 1 Star and Delta circuit.
5. 2 Line and Phase relationship
5. 3 Power equation with numerical problems

## 6. TRANSFORMER:

6. 1 State construction & working principle of transformer.
6. 2 Derive of EMF equation of transformer, voltage transformation ratio.
6. 3 Discuss operation of transformer on no-load with phasor diagram.
6. 4 Operation of transformer on load condition in secondary with phasor diagram for different load.
6. 5 Types of losses in Single Phase (1- $\phi$ ) Transformer.
6. 6 Open circuit & short-circuit test (simple problems).
6. 7 Parallel operation of Transformer.

## 7. INDUCTION MOTOR:

7. 1 Constructional feature and types of three-phase induction motor.
7. 2 Principle of development of rotating magnetic field in the stator.
7. 3 Working principle of three phase induction motor.
7. 4 Slip speed and slip of induction motor.
7. 5 Establish relation between torque, rotor current and power factor.
7. 6 Explain starting of an induction motor by using DOL and Star-Delta stator.
7. 7 Industrial use of induction motor.

**8. SINGLE PHASE INDUCTION MOTOR:**

- 8. 1 Explain construction features and principle of operation of capacitor type and shaded pole type of single-phase induction motor.
- 8. 2 Explain construction & operation of AC series motor.

**9. ALTERNATOR:**

- 9. 1 Concept of alternator & its application.

**Syllabus coverage up to Internal assessment**

Chapters: 1, 2, 3, and 4.

| LEARNING RESOURCES: |                                 |                     |                       |
|---------------------|---------------------------------|---------------------|-----------------------|
| Sl.No               | Title of the Book               | Name of Authors     | Name of the publisher |
| 1.                  | Fundamental of Electrical Engg  | B.L.Theraja         | S Chand               |
| 2.                  | Electrical Machines             | Dr.S.K.Bhattachary  | TMH                   |
| 3.                  | Electrical Technology           | H.Cotton            | Pitman                |
| 4.                  | Principle of Electrical Machine | V K Mehta & R Mehta | S Chand               |

## Th2. Analog Electronics and OP-AMP

|                                                            |         |                           |                 |
|------------------------------------------------------------|---------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (I&C)Engineering |         |                           |                 |
| Course code:                                               |         | Semester                  | 4 <sup>th</sup> |
| Total Period:                                              | 60      | Examination               | 3 hrs           |
| Theory periods:                                            | 4P/week | Internal Assessment :     | 20              |
| Maximum marks:                                             | 100     | End Semester Examination: | 80              |

### A. Rationale:

Electrical Engineers use electronic devices and circuits in various fields. The modern electrical plants need help of solid state electronic circuits for control, starting etc. So it was felt to provide a subject having electronic devices and circuits for the electrical students. Study of practical circuits and components have been dealt here with in the theoretical approach.

### B. Objectives:

1. To develop knowledge on the characteristics of different types of diodes, transistors, UJT, FET and to draw a comparison in their characteristics and application.
2. To develop knowledge of their application.
3. To develop knowledge of different oscillator circuits and to identify the difference between them and their frequency relation.
4. To develop knowledge of operational amplifiers and their application in the field.

### C. TOPIC WISE DISTRIBUTION OF PERIODS

| Sl No.       | Name of the Topic                   | Periods   |
|--------------|-------------------------------------|-----------|
| 1            | P-N JUNCTION DIODE                  | 6         |
| 2            | SPECIAL SEMICONDUCTOR DEVICES       | 5         |
| 3            | RECTIFIER CIRCUITS & FILTERS        | 7         |
| 4            | TRANSISTORS                         | 7         |
| 5            | TRANSISTOR CIRCUITS                 | 7         |
| 6            | TRANSISTOR AMPLIFIERS & OSCILLATORS | 13        |
| 7            | FIELD EFFECT TRANSISTOR             | 6         |
| 8            | OPERATIONAL AMPLIFIERS              | 9         |
| <b>Total</b> |                                     | <b>60</b> |

### D. Course Content:

1. P-N JUNCTION DIODE:
  - 1.1 P-N Junction Diode
  - 1.2 Working of Diode
  - 1.3 V-I characteristic of PN junction Diode.
  - 1.4 DC load line
  - 1.5 Important terms such as Ideal Diode, Knee voltage
  - 1.6 Junctions break down.
    - 1.6.1 Zener breakdown
    - 1.6.2 Avalanche breakdown
  - 1.7 P-N Diode clipping Circuit.
  - 1.8 P-N Diode clamping Circuit

2. **SPECIAL SEMICONDUCTOR DEVICES:**

- 2 . 1 Thermistors, Sensors & barretters
- 2 . 2 Zener Diode
- 2 . 3 Tunnel Diode
- 2 . 4 PIN Diode

3. **RECTIFIER CIRCUITS & FILTERS:**

- 3.1 Classification of rectifiers
- 3.2 Analysis of half wave, full wave centre tapped and Bridge rectifiers and calculate:
  - 3.2.1 DC output current and voltage
  - 3.2.2 RMS output current and voltage
  - 3.2.3 Rectifier efficiency
  - 3.2.4 Ripple factor
  - 3.2.5 Regulation
  - 3.2.6 Transformer utilization factor
  - 3.2.7 Peak inverse voltage
- 3.3 Filters:
  - 3.3.1 Shunt capacitor filter
  - 3.3.2 Choke input filter
  - 3.3.3  $\pi$  filter

4. **TRANSISTORS:**

- 4.1 Principle of Bipolar junction transistor
- 4.2 Different modes of operation of transistor
- 4.3 Current components in a transistor
- 4.4 Transistor as an amplifier
- 4.5 Transistor circuit configuration & its characteristics
  - 4.5.1 CB Configuration
  - 4.5.2 CE Configuration
  - 4.5.3 CC Configuration

5. **TRANSISTOR CIRCUITS:**

- 5.1 Transistor biasing
- 5.2 Stabilization
- 5.3 Stability factor
- 5.4 Different method of Transistors Biasing
  - 5.4.1 Base resistor method
  - 5.4.2 Collector to base bias
  - 5.4.3 Self bias or voltage divider method

6. **TRANSISTOR AMPLIFIERS & OSCILLATORS:**

- 6.1 Practical circuit of transistor amplifier
- 6.2 DC load line and DC equivalent circuit
- 6.3 AC load line and AC equivalent circuit
- 6.4 Calculation of gain
- 6.5 Phase reversal
- 6.6 H-parameters of transistors
- 6.7 Simplified H-parameters of transistors

- 6.8 Generalised approximate model
- 6.9 Analysis of CB, CE, CC amplifier using generalised approximate model
- 6.10 Multi stage transistor amplifier
  - 6.10.1 R.C. coupled amplifier
  - 6.10.2 Transformer coupled amplifier
- 6.11 Feed back in amplifier
  - 6.11.1 General theory of feed back
  - 6.11.2 Negative feedback circuit
  - 6.11.3 Advantage of negative feed back
- 6.12 Power amplifier and its classification
  - 6.12.1 Difference between voltage amplifier and power amplifier
  - 6.12.2 Transformer coupled class A power amplifier
    - 6.12.3 Class A push – pull amplifier
    - 6.12.4 Class B push – pull amplifier
- 6.13 Oscillators
  - 6.13.1 Types of oscillators
  - 6.13.2 Essentials of transistor oscillator
  - 6.13.3 Principle of operation of tuned collector, Hartley, colpitt, phase shift, wein-bridge oscillator (no mathematical derivations)

7. **FIELD EFFECT TRANSISTOR:**

- 7.1 Classification of FET
- 7.2 Advantages of FET over BJT
- 7.3 Principle of operation of BJT
- 7.4 FET parameters (no mathematical derivation)
  - 7.4.1 DC drain resistance
  - 7.4.2 AC drain resistance
  - 7.4.3 Trans-conductance
- 7.5 Biasing of FET

8. **OPERATIONAL AMPLIFIERS:**

- 8.1 General circuit simple of OP-AMP and IC – CA – 741 OP AMP
- 8.2 Operational amplifier stages
- 8.3 Equivalent circuit of operational amplifier
- 8.4 Open loop OP-AMP configuration
- 8.5 OPAMP with fed back
- 8.6 Inverting OP-AMP
- 8.7 Non inverting OP-AMP
- 8.8 Voltage follower & buffer
- 8.9 Differential amplifier
  - 8.9.1 Adder or summing amplifier
  - 8.9.2 Sub tractor
  - 8.9.3 Integrator
  - 8.9.4 Differentiator
  - 8.9.5 Comparator

**Syllabus coverage up to Internal assessment**

Chapters: 1, 2, 3, 4 and 5.

| <b>Learning Resources:</b> |                        |                                    |                              |
|----------------------------|------------------------|------------------------------------|------------------------------|
| <b>Sl.No</b>               | <b>Name of Authors</b> | <b>Title of the Book</b>           | <b>Name of the publisher</b> |
| 1                          | Sanjeev Gupta          | Electronic Devices and<br>Circuits | Dhanpat Rai<br>Publications  |
| 2                          | R.S SEDHA              | Electronics circuit                | S.CHAND                      |

### Th3. ELECTRICAL MEASUREMENT & INSTRUMENTATION

|                                                                                    |                |                           |                 |
|------------------------------------------------------------------------------------|----------------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (Instrumentation and Control)Engineering |                |                           |                 |
| Course code:                                                                       |                | Semester                  | 4 <sup>th</sup> |
| Total Period:                                                                      | 75 (60L + 15T) | Examination               | 3 hrs           |
| Theory periods:                                                                    | 4P / week      | Internal Assessment :     | 20              |
| Tutorial:                                                                          | 1 P / week     |                           |                 |
| Maximum marks:                                                                     | 100            | End Semester Examination: | 80              |

#### A. RATIONALE :

The subjects deal with the methods of measuring voltage, current, power, energy, frequency, power factor & line parameters, and principle of operation of the instruments used for such measurements. Also it provides the methods to extend the range of low range instruments to measure higher values. A power measurement includes measurement of DC power, AC single phase power and AC three phase power. Also accuracy, precision, resolution and errors and their correction are very important and have been fully discussed. Since the whole system is a combination of analog and digital system in Industry, the topics of both the system have been studied along with the topics of sensors, their characteristics and their interfacing with analog and digital system under this subject.

#### B. OBJECTIVES :

1. To acquire the knowledge of selecting various types of instruments for similar purpose like measurement of voltage, current, power factor, frequency etc.
2. To learn the connection of different types of electrical measuring instruments.
3. To learn the adjustment of different instruments.
4. To understand the working principle and construction of the electrical instruments.
5. To solve different numerical problems associated with the instruments based on their design Formula.
6. To acquire knowledge of the construction, characteristics and methods of usage of sensors and transducers.

#### C. TOPIC WISE DISTRIBUTION OF PERIODS

| Sl. No. | Topic                                               | Periods   |
|---------|-----------------------------------------------------|-----------|
| 1.      | Measuring instruments                               | 05        |
| 2.      | Analog ammeters and voltmeters                      | 10        |
| 3.      | Wattmeter and measurement of power                  | 08        |
| 4.      | Energy meters and measurement of energy             | 08        |
| 5.      | Measurement of speed, frequency and power factor    | 07        |
| 6.      | Measurement of Resistance, Inductance & Capacitance | 08        |
| 7.      | Sensors And Transducer                              | 09        |
| 8.      | Oscilloscope                                        | 05        |
|         | <b>TOTAL</b>                                        | <b>60</b> |

#### D. COURSE CONTENT IN TERMS OF SPECIFIC OBJECTIVES

##### 1. MEASURING INSTRUMENTS

- 1.1 Define Accuracy, precision, Errors, Resolutions Sensitivity and tolerance.
- 1.2 Classification of measuring instruments.
- 1.3 Explain Deflecting, controlling and damping arrangements in indicating type of instruments.

- 1.4 Calibration of instruments.
- 2. ANALOG AMMETERS AND VOLTMETERS**
  - 2.1. Describe Construction, principle of operation, errors, ranges merits and demerits of:
    - 2.1.1 Moving iron type instruments.
    - 2.1.2 Permanent Magnet Moving coil type instruments.
    - 2.1.3 Dynamometer type instruments
    - 2.1.4 Rectifier type instruments
    - 2.1.5 Induction type instruments
  - 2.2 Extend the range of instruments by use of shunts and Multipliers.
  - 2.3 Solve Numerical
- 3. WATTMETERS AND MEASUREMENT OF POWER**
  - 3.1 Describe Construction, principle of working of Dynamometer type wattmeter. (LPF and UPF type)
  - 3.2 The Errors in Dynamometer type wattmeter and methods of their correction.
  - 3.3 Discuss Induction type watt meters.
- 4. ENERGYMETERS AND MEASUREMENT OF ENERGY**
  - 4.1 Introduction
  - 4.2 Single Phase Induction type Energy meters – construction, working principle and their compensation & adjustments.
  - 4.3 Testing of Energy Meters.
- 5. MEASUREMENT OF SPEED, FREQUENCY AND POWER FACTOR**
  - 5.1 Tachometers, types and working principles
  - 5.2 Principle of operation and construction of Mechanical and Electrical resonance Type frequency meters.
  - 5.3 Principle of operation and working of Dynamometer type single phase and three phase power factor meters.
- 6. MEASUREMENT OF RESISTANCE, INDUCTANCE & CAPACITANCE**
  - 6.1 Classification of resistance
    - 6.1.1. Measurement of low resistance by potentiometer method. .
    - 6.1.2. Measurement of medium resistance by wheat Stone bridge method.
    - 6.1.3. Measurement of high resistance by loss of charge method.
  - 6.2 Construction, principle of operations of Megger & Earth tester for insulation resistance and earth resistance measurement respectively.
  - 6.3 Construction and principles of Multimeter. (Analog and Digital)
  - 6.4 Measurement of inductance by Maxwell's Bridge method.
  - 6.5 Measurement of capacitance by Schering Bridge method
- 7. SENSORS AND TRANSDUCER**
  - 7.1. Define Transducer, sensing element or detector element and transduction elements.
  - 7.2. Classify transducer. Give examples of various class of transducer.
  - 7.3. Resistive transducer
    - 7.3.1 Linear and angular motion potentiometer.
    - 7.3.2 Thermistor and Resistance thermometers.
    - 7.3.3 Wire Resistance Strain Gauges
  - 7.4. Inductive Transducer
    - 7.4.1 Principle of linear variable differential Transformer (LVDT)
    - 7.4.2 Uses of LVDT.

- 7.5. Capacitive Transducer.
  - 7.5.1 General principle of capacitive transducer.
  - 7.5.2 Variable area capacitive transducer.
  - 7.5.3 Change in distance between plate capacitive transducer.
- 7.6. Piezo electric Transducer and Hall Effect Transducer with their applications.

## 8. OSCILLOSCOPE

- 8.1. Principle of operation of Cathode Ray Tube.
- 8.2. Principle of operation of Oscilloscope (with help of block diagram).
- 8.3. Measurement of DC Voltage & current.
- 8.4. Measurement of AC Voltage, current, phase & frequency.

### Syllabus coverage up to Internal assessment

Chapters: 1, 2, 3 and 4.

| Learning Resources: |                                                                  |                         |                    |
|---------------------|------------------------------------------------------------------|-------------------------|--------------------|
| Sl.No               | Title of the Book                                                | Name of Author          | Publisher          |
| 1.                  | Electrical & Electronic Measurements and Instrumentation         | R.K.Rajput              | S.Chand            |
| 2.                  | Electric Measurement and Measuring instruments                   | A.K. Sawhney            | Dhanpat Rai & Co   |
| 3.                  | Electrical and Electronics Measuring instruments and Measurement | J. B. Gupta             | S K Kataria & Sons |
| 4.                  | Electrical Measurement and Measuring instruments                 | E.W. Golding & H Widdis | Wheeler Publishing |
| 5.                  | Industrial Instrumentation and Control                           | S K Singh               | TMH Ltd.           |
| 6.                  | Electrical and Electronic Measurement and Instrumentation.       | S K Bhattacharya        | Vikas              |

## Th4. GENERATION TRANSMISSION & DISTRIBUTION

|                                                                                    |                |                           |                 |
|------------------------------------------------------------------------------------|----------------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (Instrumentation and Control)Engineering |                |                           |                 |
| Course code:                                                                       |                | Semester                  | 4 <sup>th</sup> |
| Total Period:                                                                      | 75 (60L + 15T) | Examination               | 3 hrs           |
| Theory periods:                                                                    | 4P / week      | Internal Assessment ::    | 20              |
| Tutorial:                                                                          | 1 P / week     |                           |                 |
| Maximum marks:                                                                     | 100            | End Semester Examination: | 80              |

### A. RATIONALE :

Power system comprises generation, transmission and distribution. In this subject generation, transmission and distribution, types of generation schemes, transmission with transmission loss and efficiencies, different type of sub-stations, different type of distribution schemes, EHV AC and HV DC overhead transmission, underground cable transmission and economic aspects involved are dealt with. Further, types of tariff are briefly included to give brief and overall idea to the students.

### B. OBJECTIVES :

After completion of this subject the student will be able to:

1. Different schemes of power generation with their block diagram.
2. Mechanical and electrical design of transmission lines and numerical problems.
3. Types of cables and their methods of laying and testing.
4. Different schemes of distribution with problem solving
5. Different types of sub-stations.
6. Economic aspects of power supply system with problem and type of tariff of electricity.

### C. TOPIC WISE DISTRIBUTION OF PERIODS

| Sl. No.      | Topics                              | Periods   |
|--------------|-------------------------------------|-----------|
| 1.           | Generation of electricity           | 07        |
| 2.           | Transmission of electric power      | 05        |
| 3.           | Over head line                      | 07        |
| 4.           | Performance of short & medium lines | 07        |
| 5.           | EHV transmission                    | 07        |
| 6.           | Distribution System                 | 07        |
| 7.           | Underground cable                   | 06        |
| 8.           | Economic Aspects                    | 06        |
| 9.           | Types of tariff                     | 03        |
| 10.          | Substation                          | 05        |
| <b>TOTAL</b> |                                     | <b>60</b> |

**D. COURSE CONTENTS IN TERMS OF SPECIFIC OBJECTIVES.**

**1. GENERATION OF ELECTRICITY**

- 1.1 Elementary idea on generation of electricity from Thermal, Hydel, Nuclear, Power station.
- 1.2 Introduction to Solar Power Plant (Photovoltaic cells).
- 1.3 Layout diagram of generating stations.

**2. TRANSMISSION OF ELECTRIC POWER**

- 2.1 Layout of transmission and distribution scheme.
- 2.2 Voltage Regulation & efficiency of transmission.
- 2.3 State and explain Kelvin's law for economical size of conductor.
- 2.4 Corona and corona loss on transmission lines.

**3. OVER HEAD LINES**

- 3.1 Types of supports, size and spacing of conductor.
- 3.2 Types of conductor materials.
- 3.3 State types of insulator and cross arms.
- 3.4 Sag in overhead line with support at same level and different level. (approximate formula effect of wind, ice and temperature on sag)
- 3.5 Simple problem on sag.

**4. PERFORMANCE OF SHORT & MEDIUM LINES**

- 4.1. Calculation of regulation and efficiency.

**5. EHV TRANSMISSION**

- 5.1 EHV AC transmission.
  - 5.1..1. Reasons for adoption of EHV AC transmission.
  - 5.1..2. Problems involved in EHV transmission.
- 5.2 HV DC transmission.
  - 5.2..1. Advantages and Limitations of HVDC transmission system.

**6. DISTRIBUTION SYSTEMS**

- 6.1 Introduction to Distribution System.
- 6.2 Connection Schemes of Distribution System: (Radial, Ring Main and Inter connected system)
- 6.3 DC distributions.
  - 6.3.1 Distributor fed at one End.
  - 6.3.2 Distributor fed at both the ends.
  - 6.3.3 Ring distributors.
- 6.4 AC distribution system.
  - 6.4.1. Method of solving AC distribution problem.
  - 6.4.2. Three phase four wire star connected system arrangement.

**7. UNDERGROUND CABLES**

- 7.1 Cable insulation and classification of cables.
- 7.2 Types of L. T. & H.T. cables with constructional features.

- 7.3 Methods of cable lying.
- 7.4 Localization of cable faults: Murray and Varley loop test for short circuit fault / Earth fault.

## 8. ECONOMIC ASPECTS

- 8.1 Causes of low power factor and methods of improvement of power factor in power system.
- 8.2 Factors affecting the economics of generation: (Define and explain)
  - 8.2.1 Load curves.
  - 8.2.2 Demand factor.
  - 8.2.3 Maximum demand.
  - 8.2.4 Load factor.
  - 8.2.5 Diversity factor.
  - 8.2.6 Plant capacity factor.
- 8.3 Peak load and Base load on power station.

## 9. TYPES OF TARIFF

- 9.1. Desirable characteristic of a tariff.
- 9.2. Explain flat rate, block rate, two part and maximum demand tariff. (Solve Problems)

## 10. SUBSTATION

- 10.1 Layout of LT, HT and EHT substation.
- 10.2 Earthing of Substation, transmission and distribution lines.

### Syllabus coverage up to Internal assessment

Chapters: 1, 2, 3, 4 and 5.

| Learning Resources: |                                         |                                                   |                  |
|---------------------|-----------------------------------------|---------------------------------------------------|------------------|
| Sl.No               | Title of the Book                       | Name of Author                                    | Publisher        |
| 1.                  | Principles of Power System              | V. K. Mehta                                       | S Chand          |
| 2                   | A text book of Power System Engineering | A Chakrabarti, M L Soni, P V Gupta, U S Bhatnagar | Dhanpat Rai & Co |
| 3.                  | A course of electrical power system     | S. L. Uppal                                       | Khanna publisher |
| 4.                  | Power System Engineering                | D. P. Kothari, IJ Nagrath                         | TMH              |

## Pr1. ELECTRICAL MACHINE LAB

|                                                                                    |            |                           |                 |
|------------------------------------------------------------------------------------|------------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (Instrumentation and Control)Engineering |            |                           |                 |
| Course code:                                                                       |            | Semester                  | 4 <sup>th</sup> |
| Total Period:                                                                      | 90         | Examination               | 3 hrs           |
| Lab. periods:                                                                      | 6 P / week | Sessional                 | 25              |
| Maximum marks:                                                                     | 125        | End Semester Examination: | 100             |

### A: RATIONALE:

This Lab gives understanding of different Electrical Machine i.e. Transformer, DC / AC Generator & Motor etc. The students will be able to identify different parts; perform testing of terminals and insulation testing, connections and running of the machines. They will be able to measure the electrical parameters to determine regulation & efficiency with speed control of motors. Common electrical skill improvement exercises are to be performed.

### B: OBJECTIVES:

On completing of this Laboratory Course the students will be able to:

- 1 Test the AC and DC machines, connect & run.
- 2 To determine, power consumption, efficiency and regulation.
- 3 To determine the machine Control and the speed of motors.

### C: COURSE CONTENT OF SPECIFIC OBJECTIVE:

1. Measurement of Power of a single phase AC supplied load by voltmeter, ammeter and power factor meter and verification of result connecting a watt meter.
2. Measurement of three phase power using two watt meter method.
3. Study of different parts and identification of terminals and testing of insulation resistance of a DC machine, Run a DC shunt Generator & measure speed.
4. Study of 3 point & 4 point starter.
5. Speed variation of DC shunt motor by field control and armature voltage control method.
6. Parallel operation of DC generators.
7. Connect & run a 3-phase Induction Motor using DOL & star-delta stator.
8. Identification of terminals and determination of transformation ratio of a single phase transformer.
9. Determine voltage regulation of transformer by direct loading.
10. To perform short circuit & open circuit test & find the losses & efficiency.
11. Construct switch board using cut-out, switches, plugs, holder and two ways Switch.

## Pr2. ANALOG ELECTRONICS LAB

|                                                            |            |                           |                 |
|------------------------------------------------------------|------------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical(I&C) Engineering |            |                           |                 |
| Course code:                                               |            | Semester                  | 4 <sup>th</sup> |
| Total Period:                                              | 45         | Examination               | 3 hrs           |
| Lab. periods:                                              | 3 P / week | Sessional                 | 25              |
| Maximum marks:                                             | 75         | End Semester Examination: | 50              |

### A. RATIONALE

In this practical work the students get knowledge about the Analog Systems components. They will become capable of developing and implementing Analog Circuit.

### B. OBJECTIVE

On completion of the Lab. Course the student will be able to

1. Identify the active components
2. Understand the behavior character of basic semiconductor devices
3. Understand the concept of oscillator. Amplifier, Rectifier etc.

### C. COURSE CONTENT IN TERMS OF SPECIFIC OBJECTIVES

1. Determine the input and output Characteristics of CE & CB transistor configuration
2. Determine Drain & Transfer Characteristics of JFET
3. Construct Bridge Rectifier using different filter circuit and to determine Ripple factor & analyze wave form with filter & without filter.
4. Construct Bridge Rectifier using different filter and to determine Ripple factor.
5. Construct & test the regulator using Zener diode
6. Construct different types of biasing circuit and analyze the wave form
  - (i) Fixed bias
  - (ii) Emitter bias
  - (iii) Voltage divider bias
7. Study the single stage CE amplifier & find Gain
8. Study multi stage R-C coupled amplifier & to determine frequency- response & gain.
9. Construct & Find the gain
  - (i) Class A. Amplifier
  - (ii) Class B. Amplifier
  - (iii) Class C Tuned Amplifier
10. Construct & test push pull amplifier & observe the wave form
11. Construct & calculate the frequency of
  - (i) Hartly Oscillator
  - (ii) Collpit's Oscillator
  - (iii) Wein Bridge Oscillator
  - (iv) R-C phase

shift oscillator and draw wave form & calculate the frequency

12. Construct & Test Differentiator and Integrator using R-C Circuit

13. Study Multivibrator ( Astable, Bistable, Monstable) Circuit & Draw its Wave forms

- **Mini Project:** To collect data like base configuration. Operational Characteristics, applications and critical factor etc. On all semiconductor devices studied in theory and compile a Project report throughout and submit at the end of the semester. To assemble and test simple circuit using above components with test Points.(e.g. Series Regulator / Oscillators etc)

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| Learning Resources: |                                   |                |           |
|---------------------|-----------------------------------|----------------|-----------|
| Sl. No.             | Title of the Book                 | Name of Author | Publisher |
| 1.                  | Basic electronic Lab. Manual<br>: | Paul B. Zbar   | S.Chand   |

### Pr3. SIMULATION PRACTICE ON MATLAB

|                                                                                    |           |                           |                 |
|------------------------------------------------------------------------------------|-----------|---------------------------|-----------------|
| Name of the Course: Diploma in Electrical (Instrumentation and Control)Engineering |           |                           |                 |
| Course code:                                                                       |           | Semester                  | 4 <sup>th</sup> |
| Total Period:                                                                      | 60        | Examination               | 3 hrs           |
| Lab. periods:                                                                      | 4P / week | Sessional                 | 50              |
| Maximum marks:                                                                     | 100       | End Semester Examination: | 50              |

#### A. RATIONALE:

Computer simulation is necessary for any hardware, before its fabrication. MATLAB software provides a unique platform for computer simulation. Practice on MATLAB has been opted for final semester students to be familiar with programming and simulation practice with SIMULINK to make them comfortable for designing various hardware projects and verify different experiments in absence of proto type experimental equipments.

#### B. OBJECTIVE:

1. To learn programming in MATLAB to perform mathematical manipulation.
2. To prepare virtual experiment setup for different electrical and power electronics experiments under MATLAB Simulink.

#### C. Topic wise distribution of periods:

| Sl. No. | Topics                             | No of Periods |
|---------|------------------------------------|---------------|
| 1.      | Introduction to MATLAB programming | 40            |
| 2.      | Introduction to SIMULINK           | 50            |
|         | <b>Total</b>                       | <b>90</b>     |

#### D. COURSE CONTENT (in terms of specific objective)

##### 1. Introduction to MATLAB programming:

##### 1.1. Functions and operation using variables and arrays.

1.1.1. To learn algebraic, trigonometric and exponential manipulation.

1.1.2. To learn Arithmetic, Relational and Logic operator.

##### 1.2. Matrix formation and its manipulation.

##### 1.3. Vector manipulation:

1.3.1. Use of linspace to create vectors.

1.3.2. To create, add and multiply vectors.

1.3.3. Use of sin and sqrt functions with vector arguments.

1.4. Plotting:

1.4.1. Two dimensional Plots and sub plots

1.4.2. Label the plot and printing.

1.5. Write and execute a file to plot a circle, impulse, step, ramp, sine and cosine functions. .

## 2. **Introduction to SIMULINK:**

2.1. Use of Commonly used blocks, Math operation block and Display block from SIMULINK library.

2.2. Use of logical and relational operator block.

2.3. Use of Sim-Power system block to use Electrical sources, elements and Power electronics devices.

2.4. SIMULATION:

2.4.1. Verification of Network theorems.

2.4.2. Simulation of a half wave uncontrolled rectifier.

2.4.3. Simulation of 1-phase full bridge controlled rectifier.

2.4.4. Simulation of step-down chopper.

| <b>Learning Resources:</b> |                                   |                        |                          |
|----------------------------|-----------------------------------|------------------------|--------------------------|
| <b>Sl.No</b>               | <b>Title of the Book</b>          | <b>Name of Authors</b> | <b>Name of Publisher</b> |
| 1.                         | MATLAB and Simulink for Engineers | Agam Kumar Tyagi       | Oxford                   |
| 2.                         | Getting started with MATLAB       | Rudra Pratap           |                          |
| 3.                         | MATLAB Demystified                | K K Sarma              | Vikas                    |