

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

**TEACHING AND EVALUATION SCHEME FOR 4th Semester (Electrical)(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		Energy Conversion-I	4	1	-	20	80	3	100
Th.2		Analog Electronics & OP-Amp	4		-	20	80	3	100
Th.3		Electrical Measurement & Instrumentation	4	1	-	20	80	3	100
Th.4		Generation, Transmission and Distribution	4			20	80	3	100
		<i>Total</i>	16	02		80	320	-	400
<b>Practical</b>									
Pr.1		Electrical Machine Lab-I	-	-	6	25	50	3	75
Pr.2		Analog Electronics Lab	-	-	3	25	50	3	75
Pr.3		Simulation Practice on MATLAB	-	-	3	25	50	3	75
Pr.4		Electrical Drawing			6	25	100	3	125
		Student Centered Activities(SCA)		-	3				
		<i>Total</i>	-	-	21	100	250	-	350
		<b>Grand Total</b>	<b>16</b>	<b>02</b>	<b>21</b>	<b>180</b>	<b>520</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.**

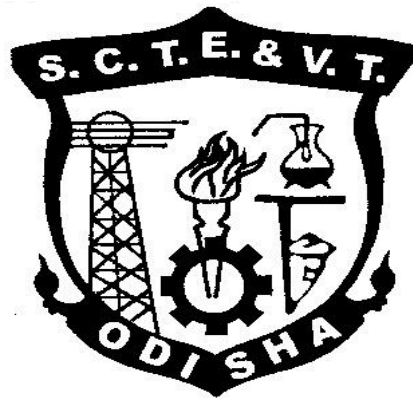
**There shall be 1 Internal Assessment done for each of the Theory Subject. Sessional Marks shall be total of the performance of individual different jobs/ experiments in a subject throughout the semester**

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

**For**

**DIPLOMA IN ENGINEERING**

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



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

**Th1. ENERGY CONVERSION – I**

Name of the Course: Diploma in Electrical 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**

Energy Conversion-I deals with DC machines and transformers. The application of DC generators and motors in modern industries are still in practice. The electrical technicians have to look after the installation, operation, maintenance and control of such machine. So the knowledge of these machines is felt essential. Transformers of various voltage ratios and KVA ratings are in wide use in industries as well as in distribution and transmission.

**B. OBJECTIVES**

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

1. To acquire knowledge of construction, characteristic and control of the DC machines.
2. To acquire knowledge on performance of DC machines and transformers.
3. To acquire knowledge of testing and maintenance of transformers and DC machines.

**C. TOPIC WISE DISTRIBUTION OF PERIODS**

Sl. No.	Topic	Periods
1.	DC GENERATORS	17
2.	DC MOTORS	15
3.	SINGLE PHASE TRANSFORMER	20
4.	AUTO TRANSFORMER	03
5.	INSTRUMENT TRANSFORMERS	05
TOTAL		60

**D. COURSE CONTENT IN TERMS OF SPECIFIC OBJECTIVES****1. D.C GENERATOR**

- 1.1. Operating principle of generator
- 1.2. Constructional features of DC machine.
  - 1.2.1. Yoke, Pole & field winding, Armature, Commutator.
  - 1.2.2. Armature winding, back pitch, Front pitch, Resultant pitch and commutator- pitch.
  - 1.2.3. Simple Lap and wave winding, Dummy coils.
- 1.3. Different types of D.C. machines (Shunt, Series and Compound)
- 1.4. Derivation of EMF equation of DC generators. (Solve problems)
- 1.5. Losses and efficiency of DC generator. Condition for maximum efficiency and numerical problems.

- 1.6. Armature reaction in D.C. machine
- 1.7. Commutation and methods of improving commutation.
  - 1.7.1. Role of inter poles and compensating winding in commutation.
- 1.8. Characteristics of D.C. Generators
- 1.9. Application of different types of D.C. Generators.
- 1.10. Concept of critical resistance and critical speed of DC shunt generator
- 1.11. Conditions of Build-up of emf of DC generator.
- 1.12. Parallel operation of D.C. Generators.
- 1.13. Uses of D.C generators.

## 2. D. C. MOTORS

- 2.1. Basic working principle of DC motor
- 2.2. Significance of back emf in D.C. Motor.
- 2.3. Voltage equation of D.C. Motor and condition for maximum power output(simple problems)
- 2.4. Derive torque equation (solve problems)
- 2.5. Characteristics of shunt, series and compound motors and their application.
- 2.6. Starting method of shunt, series and compound motors.
- 2.7. Speed control of D.C shunt motors by Flux control method. Armature voltage Control method. Solve problems
- 2.8. Speed control of D.C. series motors by Field Flux control method, Tapped field method and series-parallel method
- 2.9. Determination of efficiency of D.C. Machine by Brake test method(solve numerical problems)
- 2.10. Determination of efficiency of D.C. Machine by Swinburne's Test method(solve numerical problems)
- 2.11. Losses, efficiency and power stages of D.C. motor(solve numerical problems)
- 2.12. Uses of D.C. motors

## 3. SINGLE PHASE TRANSFORMER

- 3.1 Working principle of transformer.
- 3.2 Constructional feature of Transformer.
  - 3.2.1 Arrangement of core & winding in different types of transformer.
  - 3.2.2 Brief ideas about transformer accessories such as conservator, tank, breather, and explosion vent etc.
  - 3.2.3 Explain types of cooling methods
- 3.3 State the procedures for Care and maintenance.
- 3.4 EMF equation of transformer.
- 3.5 Ideal transformer voltage transformation ratio
- 3.6 Operation of Transformer at no load, on load with phasor diagrams.
- 3.7 Equivalent Resistance, Leakage Reactance and Impedance of transformer.
- 3.8 To draw phasor diagram of transformer on load, with winding Resistance and Magnetic leakage with using pf, leading pf and lagging pf load.
- 3.9 To explain Equivalent circuit and solve numerical problems.
- 3.10 Approximate & exact voltage drop calculation of a Transformer.
- 3.11 Regulation of transformer.
- 3.12 Different types of losses in a Transformer. Explain Open circuit and Short Circuit test.(Solve numerical problems)
- 3.13 Explain Efficiency, efficiency at different loads and power factors, condition for maximum efficiency (solve problems)
- 3.14 Explain All Day Efficiency (solve problems)
- 3.15 Determination of load corresponding to Maximum efficiency.
- 3.16 Parallel operation of single phase transformer.

**4. AUTO TRANSFORMER**

- 4.1. Constructional features of Auto transformer.
- 4.2. Working principle of single phase Auto Transformer.
- 4.3. Comparison of Auto transformer with an two winding transformer (saving of Copper).
- 4.4. Uses of Auto transformer.
- 4.5. Explain Tap changer with transformer (on load and off load condition)

**5. INSTRUMENT TRANSFORMERS**

- 1.1 Explain Current Transformer and Potential Transformer
- 1.2 Define Ratio error, Phase angle error, Burden.
- 1.3 Uses of C.T. and P.T.

**Syllabus coverage up to Internal assessment**

Chapters: 1 and 2.

<b>Learning Resources:</b>			
<b>Sl.No</b>	<b>Title of the Book</b>	<b>Name of Author</b>	<b>Publisher</b>
1	<i>Electrical Technology – II</i>	<i>B. L. Thareja and A. K. Thareja</i>	<i>S.Chand</i>
2	<i>A Textbook of Electrical Machines</i>	<i>K R Siddhapura, D B Raval</i>	<i>Vikas</i>
3.	<i>Electrical Technology</i>	<i>J. B. Gupta</i>	<i>S.K.Kataria and Sons</i>
4.	<i>Electric Machine</i>	<i>Ashfaq Husain</i>	<i>Dhanpat Rai and Sons</i>
5.	<i>Electrical Machine</i>	<i>S. K. Bhattacharya</i>	<i>TMH</i>
6.	<i>Electrical Machines</i>	<i>D P Kothari, I J Nagrath</i>	<i>Mc Graw Hill</i>
7	<i>Electrical Machines</i>	<i>Prithwiraj purakait and Indrayudh Bandyopadhyay</i>	<i>OXFORD</i>

## Th2. Analog Electronics and OP-AMP

Name of the Course: Diploma in Electrical 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 Circuits	Dhanpat Rai Publications
2	R.S SEDHA	Electronics circuit	S.CHAND

### Th3. ELECTRICAL MEASUREMENT & INSTRUMENTATION

Name of the Course: Diploma in Electrical 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. ENERGY METERS 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.

<b>Learning Resources:</b>			
<b>Sl.No</b>	<b>Title of the Book</b>	<b>Name of Author</b>	<b>Publisher</b>
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 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 :

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 laying.
- 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.

<b>Learning Resources:</b>			
<b>Sl.No</b>	<b>Title of the Book</b>	<b>Name of Author</b>	<b>Publisher</b>
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-I**

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester	4 <sup>th</sup>
Total Period:	90	Examination	3 hrs
Lab. periods:	6 P / week	Sessional	25
Maximum marks:	75	End Semester Examination:	50

**A. RATIONALE:** The sole objective of the subject is to be familiar with machines and different parts. To perform practice of the experiments and become fit to meet the challenges in practical implementation.

In the beginning the faculties have to illustrate all the tools and instruments required/ used in conducting the experiments.

**B. OBJECTIVES:**

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

1. To be familiar with constructional features, terminal testing, insulation testing of DC machines, and Transformers.
2. Know methods of Starting and Speed control of DC machines.
3. To determine efficiency, regulations of different machines.
4. To draw and study performance characteristics.
5. Load sharing of transformers.

**C. LIST OF EXPERIMENTS:**

1. Identification of different terminals of a DC machine by test lamp method and multi-meter method & to measure insulation resistance by megger.
2. Dimensional and material study of various parts of a DC machine.
3. Plot OCC of a DC shunt generator at constant speed and determine critical resistance from the graph.
4. Plot External Characteristics of a DC shunt generator at constant speed.
5. Study of Three point starter, connect and run a DC shunt motor & measure the no load current.
6. Study of Four point starter, connect and run a DC compound motor & measure no load current.
7. Control the speed of a DC shunt motor by field flux control method & armature voltage control method.
8. Determine the armature current vs. speed characteristic of a DC motor
9. Determine the efficiency of a DC machine by brake test method.
10. Identification of terminals, determination of voltage transformation ratio of a single phase transformer.
11. Perform OC Test and SC test of a single phase transformer.
12. Determine the voltage regulation of a single phase transformer at different loads.



13. Polarity test of single phase transformer and parallel operation of two single phase transformers.

<b>Learning Resources:</b>			
<b>Sl. No.</b>	<b>Title of the Book</b>	<b>Name of Author</b>	<b>Publisher</b>
1.	Laboratory courses in Electrical Engineering	S G Tarnekar; P K Kharbanda; S D Naik et.al	S.Chand

## Pr2. ANALOG ELECTRONICS LAB

Name of the Course: Diploma in Electrical 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 :	Paul B. Zbar	S.Chand

### Pr3. SIMULATION PRACTICE ON MATLAB

Name of the Course: Diploma in Electrical 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:

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	20
2.	Introduction to SIMULINK	25
	<b>Total</b>	<b>45</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.

**Learning Resources:**

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

## Pr4. ELECTRICAL DRAWING

Name of the Course: Diploma in Electrical Engineering			
Course code:		Semester:	4 <sup>th</sup>
Total Period:	90	Examination:	3 hrs
Theory periods:	6 P/week	Term work:	25
Maximum marks:	125	End Semester Examination:	100

### A. Rationale:

A technical person takes help of an engineering drawing to understand the constructional features of machines and accessories. Electrical drawing is introduced for the final year students to be familiar with Circuit diagrams of AC motors starters, Development of stator windings with conventional symbols.

Sketching as to BIS and REC specification and symbol of electrical earthing installations, SP and DP structures and substations of 132/33 kV and 33/11 kV type. This will enable them to follow engineering drawing in the working environment.

### B. Objectives:

1. To draw wiring circuit diagram for different AC and DC motor starters.
2. To follow BIS and REC standard to draw earthing installation and SP and DP Structures and stay sets for line supports.
3. To use various symbols to draw the single line diagram of 33/11kV substations.

### C. TOPIC WISE DISTRIBUTION OF PERIODS

Sl. No.	Topics	Periods
1.	Wiring Diagram of Starters	18
2.	Development of DC armature winding	18
3.	1 $\phi$ and 3 $\phi$ transformer	12
4.	Sketches of Earthing and LT and HT line	18
5.	Single line diagram sub station	09
6.	Auto CAD practice	15
	<b>Total</b>	<b>90</b>

### D. COURSE CONTENT:

1. **WIRING DIAGRAM AND CONTROL CIRCUIT**
  - 1.1 3 point D. C. motor starter.
  - 1.2 4 point D.C. motor starter.
  - 1.3 DOL starter
  - 1.4 Star delta starter.
  - 1.5 Auto Transformer Starter.
  - 1.6 Rotor resistance starter.
2. **DRAW D.C. M/C PARTS** (Dimensional Drawing)
  - 2.1. Pole with pole shoes.
  - 2.2. Commutator
  - 2.3. Armature
  - 2.4. DC. armature winding
    - (a) Simple lap winding
    - (b) Simple wave winding.
3. **DRAW 1-PHASE & 3-PHASE TRANSFORMER** (Assembly Drawing)
  - 3.1 Stepped core type.
  - 3.2 Plane shell type.
5. **DRAW SKETCHES OF THE FOLLOWING AS PER B.I.S AND REC SPECIFICATIONS**
  - 5.1 Earthing installation.
  - 5.2 Double pole structure for LT and HT distribution lines.
6. **DRAW SINGLE LINE DIAGRAM OF SUBSTATION**
  - 6.1 Single line diagram of 33/11kV distribution substation.
  - 6.2 Single line diagram of a 11/0.4 kV distribution substation.
8. **COMPUTER AIDED ELECTRICAL DRAWING USING SOFT WARE**
  - 8.1 Draw Electrical symbols (take Print out)
  - 8.2 Draw D.C. m/c parts (take print out)
  - 8.3 Draw A. C. m/c parts (take print out)
  - 8.4 Draw electrical layout of diagram of Electrical Installation of a building.

<b>Learning Resources:</b>			
<b>Sl.No</b>	<b>Title of the Book</b>	<b>Name of Authors</b>	<b>Name of the publisher</b>
1	<i>Electrical Design and Drawing</i>	<i>Surjit Singh</i>	<i>Dhanpat Rai &amp; Sons</i>
2	<i>Electrical Engineering Drawing</i>	<i>C.R. Dargan</i>	<i>Asian Publication</i>

## Equipment List

### ANALOG ELECTRONICS LAB

Sl. No.	Equipment
1	Breadboard
2	Regulated Power Supply
3	Digital Multimeter
4	JFET Characteristics Trainer kit
5	Rectifier Trainer with Filter
6	Voltage Regulator Trainer Kit using Zener Diode
7	BJT Biasing Trainer (fixed Bias, Emitter Bias, Voltage Divider Bias, Collector Feedback Bias)
8	CE amplifier Trainer
9	RC couple Amplifier Trainer
10	CRO with Probes
11	Step Down Transformer
12	Zener Diode
13	Function Generator
14	Class A, Class B, Class C Tuned Amplifier Trainer
15	Oscillator Trainer kit (Heartly osicalltor, collpits oscillator. Wein Bridge Oscillator, RC Phase Shift Oscillator)
16	Transistor Configuration Trainer Kit
17	Push Pull Amplifier Trainer
18	OPamp Trainer Kit for Differentiation and Integration
19	Multivibrator Trainer Kit (Astable, Bistable, Monostable)



**ELECTRICAL MACHINE LAB-I**

<b>Sl. No.</b>	<b>Equipment</b>
1	DC SHUNT MOTOR coupled with a DC SHUNT GENERATOR (MG SET)
2	DC SERIES MOTOR
3	DC SHUNT MOTOR
4	DC COMPOUND MOTOR
5	1- PHASE TRANSFORMER
6	MULTIMETER
7	MEGGER
8	VOLTMETER
9	AMMETER
10	WATTMETER
11	TACHOMETER
12	P.F METER
13	VARIABLE RESISTANCE
14	RESISTIVE LOAD BOX
15	LAMP LOAD BOX
16	3 POINT STARTER
17	4 POINT STARTER
18	1PH VARIAC
19	SPRING WEIGHT
20	STAR DELTA STARTER
21	3PHASE INDUCTION MOTOR -SHUNT GENERATOR SET
22	DRUM CONTROL
23	INDUCTIVE LOAD(VARIABLE)
24	CAPACITIVE LOAD
25	2 POINT STARTER
26	OHM METRE