

## 5.1 AC MACHINES

L P  
Periods 5 4

### RATIONALE

Electrical machines is a subject where a student will deal with various types of electrical machines which are employed in industries power stations domestic and commercial appliances etc. After studying this subject an electrical diploma holder must be competent to repair and maintain these machines and give suggestions to improve their performance. Explanation of practical aspects of the subject will make the students capable of performing various tests on the machines as per latest BIS specifications

### DETAILED CONTENTS

1. Synchronous Machines and their applications (30 Periods)
  - 1.1 Main constructional features of synchronous machine including commutator and brushless excitation system
  - 1.2 Generation of three phase emf
  - 1.3 Production of rotating magnetic field in a three phase winding
  - 1.4 Concept of distribution factor and coil span factor and emf equation  
Armature reaction at unity lag and lead power factor
  - 1.5 Operation of single synchronous machine independently supplying a load Voltage regulation by synchronous impedance method
  - 1.6 Need and necessary conditions of parallel operation of alternators  
Synchronizing an alternator (Synchroscope method) with the bus bars
  - 1.7 Operation of synchronous machine as a motor –its starting methods
  - 1.8 Effect of change in excitation of a synchronous motor
  - 1.9 Concept and Cause of hunting and its prevention
  - 1.10 Rating and cooling of synchronous machines
  
2. Induction Motors and their applications (30 Periods)
  - 2.1 Salient constructional features of squirrel cage and slip ring 3phase induction motors
  - 2.2 Principle of operation slip and its significance
  - 2.3 Locking of rotor and stator fields
  - 2.4 Rotor resistance inductance emf and current
  - 2.5 Relationship between copper loss and the motor slip
  - 2.6 Power flow diagram of an induction motor
  - 2.7 Factors determining the torque
  - 2.8 Torqueslip curve stable and unstable zones
  - 2.9 Effect of rotor resistance upon the torque slip relationship
  - 2.10 Double cage rotor motor and its applications
  - 2.11 Starting of 3phase induction motors DOL stardelta auto transformer
  - 2.12 Causes of low power factor of induction motors

- 2.13 Testing of 3phase motor on no load and blocked rotor test and to find efficiency
- 2.14 Speed control of induction motor
- 2.15 Harmonics and its effects cogging and crawling in Induction Motors

3. Fractional kW Motors and their applications (20 Periods)

- 3.1 Single phase induction motors; Construction characteristics and applications
- 3.2 Nature of field produced in single phase induction motor
- 3.3 Split phase induction motor
  - 3.3.1 Capacitors start and run motor
  - 3.3.2 Shaded pole motor
  - 3.3.3 Reluctance start motor
- 3.4 Alternating current series motor and universal motors
- 3.5 Single phase synchronous motor
  - 3.5.1 Reluctance motor
  - 3.5.2 Hysteresis motor

Stepper motor

- 3.6 Comparison of 3 phase and Single phase Induction motor

**LIST OF PRACTICALS**

1. To plot relationship between no load terminal voltage and excitation current in a synchronous generator at constant speed
2. Determination of the relationship between the voltage and load current of an alternator keeping excitation and speed constant
3. Determination of the regulation and efficiency of alternator from the open circuit and short circuit test
4. Synchronization of poly phase alternators and load sharing
5. Determination of the effect of variation of excitation on performance of a synchronous motor
6. Determination of efficiency by (a) no load test and blocked rotor test on an induction motor (b) direct loading of an induction motor (refer BIS code)
7. Determination of effect of rotor resistance on torque speed curve of an induction motor.
8. Study of ISI/BIS code for 3phase induction motors
9. Perform at least two tests on a 3 phase induction motor as per BIS code
10. Slip and slip measurement of three phased induction motor

**INSTRUCTIONAL STRATEGY**

Teacher should lay emphasis on development of understanding amongst students about basic principles of operation and control of electrical machines. This may be achieved by conducting quiz tests and by giving home assignments. The teachers should also conduct laboratories classes themselves encouraging each student to perform with his/her own hands and draw conclusions.

**RECOMMENDED BOOKS**

1. Electrical Machines by SK Bhattacharya Tata Mc Graw Hill New Delhi
2. Electrical Machines by SK Sahdev Uneek Publications Jalandhar

3. Electrical Machines by Nagrath and Kothari Tata Mc Graw Hill New Delhi  
Electrical Engineering by JB Gupta SK Kataria and sons New Delhi
4. Electrical Machines by Samarjit Ghosh Pearson Education (Singapore) Pvt. Ltd.  
482 FIE Patparganj Delhi 110092
5. Electrical Machines by DR Arora Ishan Publications Ambala City

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allocation (%)</b>
1	30	40
2	30	40
3	20	20
<b>Total</b>	<b>80</b>	<b>100</b>

## 5.2 CONSUMER ELECTRONICS AND TROUBLE SHOOTING

L P

Periods/week 6 4

### RATIONALE

The objective of teaching this subject is to give students an in depth knowledge of various electronic audio and video devices and systems. Further this subject will introduce the students with working principles block diagram main features of consumer electronics gadgets goods/devices like audiosystems CD systems. TV and other items like microwave ovens Photostat machines etc. Which inturn will develop in them capabilities of assembling fault diagnosis and rectification in a systematic way.

### DETAILED CONTENTS

1. **AUDIO SYSTEM:** (14 period)
  - 1.1 Microphones and Loudspeakers
    - a) Carbon moving coil cordless microphone
    - b) Direct radiating and horn loudspeaker
    - c) Multispeaker system
  - 1.2 Sound Recording
    - a) Magnetic Recording
    - b) Digital Recording
    - c) Optical Recording ( CD system and D\{D)
  - 1.3 Study of VCD and DVD Player systems.
2. **Television** (26 Periods)

Monochrome TV

  - a) Basic components of monochromatic TV
  - b) TV Receiver: Block diagram function of each block waveform at input and output of each block.

Colour Television:

  - a) Primary secondary colours
  - b) Concept of Colour Mixing Colour Triangle
  - c) Camera tube
  - d) PAL TV Receiver
  - e) Concept of Compatibility with Monochrome Receiver NTSC PAL SECAM system (brief comparison)
3. **LCD and LED Television:** (12 Period)

Basic principle and working of LCD & LED TV Plasma screens HDTV.3DTV
4. **Cable Television:** (12Periods)

Concept and Working of Cable TV DTH SetUp Box
5. **Consumer Appliances** (16 Periods)

Principle Working and troubleshooting with special emphasis on control panel

  - a) Microwave Oven

- b) Washing Machine
- c) Photostat Machine
- d) DTH System
- e) Digital Camera
- f) Induction plate
- g) Refrigerator

6. a) Repair Servicing and Maintenance Concepts

(16Periods)

Reliability aspects Mean time between failures (MTBF) Mean time to repair (MTR) Maintenance policy potential problems preventive maintenance and corrective maintenance.

b) Fundamental Trouble Shooting Procedures

- i) Fault location
- ii) Fault finding aids
  - Service manuals
  - Test and measuring instruments
  - Special tools
- iii) Trouble Shooting Techniques
  - Troubleshooting Digital Circuits
  - Troubleshooting MicroprocessorBased Systems
  - Functional Areas Approach
  - Split half method
  - Divergent convergent and feedback path circuit

**LIST OF PRACTICALS**

1. To plot the directivity pattern and frequency response of a microphone.
2. To plot the directivity pattern and frequency response of a loudspeaker.
3. Demonstration of VCD/DVD player and study of its transport mechanism
4. Familiarization with the different sections of Black and White TV Receiver.
5. To observe the wave forms and voltage of Color TV Receiver.
6. Fault finding of Color T.V Receiver.
7. Familiarization with different section of LCD & LED TV
8. Study of cable TV network system.
9. Demonstration and Operation of Control Panel
  - (a) Microwave Oven
  - (b) DTH System
  - (c) Photostat Machine
  - (d) Washing Machine

**RECOMMENDED BOOKS**

1. Audio and Video Systems by RG Gupta Tata McGraw Hill Education Pvt Ltd New Delhi
2. Colour TelevisionPrinciples & Practice by R.R Gulati Wiley Eastem Limited New Delhi
3. Complete Satellite & cable Television R.R Gulati New age Intemational PublisherNew Delhi
4. Colour Television Servicing by RC Vijay BPB Publication New Delhi
5. Colour Television & Video Technology by A.K. Maini CSB Publishers
6. Colour TV by A. Dhake
7. Service Manuals BPB Publication New Delhi

8. Modern Electronic Equipment Trouble shooting Repair and Maintenance by RS Khandpur  
TataMccraw Hill Education Pvt Ltd New Delhi

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allocation (%)</b>
1	14	15
2	26	25
3	12	10
4	12	10
5	16	20
6	16	20
<b>Total</b>	<b>96</b>	<b>100</b>

## 5.3 ELECTRICAL INSTALLATION AND ESTIMATION

L P  
Periods 6 3

### RATIONALE

This subject assumes importance in view of the fact that an electrical and electronic technician has to work in a wide spectrum of activities wherein he has to make selection from alternative schemes making technical and economical considerations; e.g. to plan and design an electrical layout using basic principles and handbooks to select equipment processes and components in different situations. The contents have been designed keeping the above objectives in view. Besides giving him basic knowledge in the topics concerned attempts have been made to ensure that the knowledge acquired is applied in various fields as per his job requirements. To orient the subject matter in the proper direction visits to industrial establishments are recommended in order to familiarize the students with the new developments in different areas

### DETAILED CONTENTS

#### 1. Estimation of Lighting and power loads

(36 Period)

Lamps and Lamp circuits : Types of lamps construction of different types of lamps Incandescent lamps Gas filled incandescent lamps Discharge lamps Sodium Vapour lamps Mercury vapour lamps Neon lamps fluorescent lamps Halogen lamps different lamp circuits for godown wiring lamp circuit incorporating energy meter cut out and distribution box.

Estimating and costing of domestic lighting installation service main types of wire specification quantity of materials required for service main estimation of cost selection of interior wiring system suitable to a given building number of circuits calculation of length of wire and quantity of accessories required estimates of cost of materials and Labour for execution of the domestic wiring installation as per National Electrical act 2003 .Power wiring installation Drawing wiring layout for a big office building electrical laboratory big industry/milk dairy/auditors/cement factory/sugar factory Big hotel with 4 storied building

with lift arrangement and a residential building with two bed room house estimation and costing upto 20 kVA calculation of load current based on ratings of various equipment's to be installed size of wire length of wire number of circuits quantity of accessories Labour cost for execution of work as per standard practice.

Irrigation pump installation Estimation and coasting upto 10 HP service main type calculation of size and quantity of wire and other components required Labour cost for erection Type of starter and control panel accessories quantity and estimation Estimate for the installation of submersible pump.

#### 2. Estimation for Over Head Lines and Earthing

(20 Period)

Distribution lines of 11 kV and 400 V OH lines estimation only quantity of materials required for lines of length 1 km of number of poles Cross arms clamps insulators conductor length and size for a given power transmission Distribution transformer erection Estimation of quantity of materials required for structures isolators HG fuse operating mechanism isolators lightening arrestors for pole mounted substation and plinth mounted substation Quantity estimation for materials required in

electrical Earthing both for pipe earthing and plate Earthing suitable to the given equipment or transformer substation

### **3. Departmental Tests and REC and Electrical Act 2003**

**(20 Period)**

Electrical installation testing departmental procedure for testing before giving service connection departmental procedure for obtaining service connection desirable insulation resistance for domestic and power circuits Tests for measuring insulation resistance procedure for conducting insulation resistance test and continuity tests earth continuity test Design of rural electrification scheme Load survey determination of capacity of transformer estimation of quantity of materials required for the erection of distribution lines and 11 kV feeder from a nearby 11 kV feeder determining the economic feasibility of the scheme as per the procedure laid out in NEC Extracts from Indian Electricity rules 1956 and code of practice by NEC regarding domestic power agricultural industrial wiring installations erection of 11 kV 400 v distribution lines pole mounted transformer

### **4. Maintenance of Electrical Machines**

**(20 Period)**

Defects in Commutator and remedies under cutting mica resurfacing of commutator brushes function and requirement brush holder function and different types staggering pf brushes brush pressure growler importance of plant maintenance types preventive maintenance Break down maintenance production maintenance Role of maintenance engineer Maintenance of Transformer Important steps in maintenance of power Transformer Difference in maintenance schedule for attended Transformers Over heating of Transformer causes of troubles and failures of cores of power Transformers Failure of power transformer due to structural defects precautions to be taken while using.

#### **LIST OF PRACTICALS**

1. Preventive maintenance of different electrical equipment available in electrical laboratories
2. Corrective maintenance of different equipment which may occur faulty during experiments/use
3. Trouble shooting of
  - Water Boiler
  - Geyser
  - Generator set
  - Pumping set
  - Heating ovens
4. Patrolling inspection and fault finding of over head lines
5. Open circuit/Short circuit/earth fault finding of machines
6. Installation of motors Diesel Generating set
7. Laying of underground cables
8. Detecting of faults in underground cables
9. Case study of maintenance department of industry/electricity board



10. To carry out the electrical estimations for the industrial/institutional or any other establishment

### **INSTRUCTIONAL STRATEGY**

This subject needs theoretical and practical inputs. Demonstration at actual site may be arranged for conceptual understanding. The subject teacher should plan in advance about the visits to the actual sites and establish liaison with the appropriate authorities/ persons with the help of HOD and Principal of the institution. The students be taken to actual workplace and explained various test procedures.

### **RECOMMENDED BOOKS**

1. Testing Commissioning Operation and Maintenance of Electrical Equipment by S Rao Khanna Technical Publication New Delhi
2. Preventive Maintenance of Electrical Apparatus by SK Sharotri Katson Publishing House Ludhiana .

### **SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic</b>	<b>Time Allotted (Periods)</b>	<b>Marks Allocation (%)</b>
1	36	33
2	20	23
3	20	22
4	20	22
<b>Total</b>	<b>96</b>	<b>100</b>

## 5.4 POWER SYSTEMS (GENERATION TRANSMISSION AND DISTRIBUTION)

L P  
Periods/Week 6 2

### RATIONALE

The majority of the polytechnic passouts who get employment in State Electricity Boards have to perform various activities in the field of Generation Transmission and Distribution of Electrical power. The range of these activities vary from simple operation and maintenance of equipment lines fault location planning and designing of simple distribution schemes executive and supervisory control in power stations transmission and distribution networks in addition to administrative jobs including public relations. They should also be made aware of recent developments current practices in the electricity departments corporations and boards to keep them abreast with modern techniques in Transmission and Distribution of Electrical Power.

### DETAILED CONTENTS

#### 1. Power Generation (27 Period)

Main resources of energy conventional and nonconventional .

**Thermal Power Station:** Thermal Power Station Principle of working Factors for selection of site. Block diagram of condensing type thermal power station Thermal power station Components and principles of working Losses of energy and methods to improve the efficiency pulverization Cooling towers and their types Main controls at Boilers Turbines Condensers and Alternators Energy auditing of thermal power station Causes of pollution and methods to control them Scheme of overall maintenance.

**Hydroelectric Power Stations:** Principle of working of hydroelectric power station limitations in location and operation. Hydraulic terms used Water power equation Classification of hydroelectric power stations based on head duty location and hydraulic considerations Layout diagram of High Head ii) Medium Head iii) Low Head Power Stations Working of surge tank fore bay spill gates Main controls of head works turbines and alternators and scheme of their maintenance.

**Nuclear and Gas Power Stations:** Nuclear energy fission and fusion reactions Merits and risks in using nuclear energy. Nuclear fuels Fission and fusion reactions with mass energy balance Fission reactions and sustained chain reaction Moderator in nuclear reactors Working of moderate type nuclear power station with a block diagram Need and working of coolant reflector control rods Materials used for them Power control by control rods measures to control radioactivity main controls at the reactor overall maintenance of the nuclear power station Principle and working of gas power plant main controls for gas turbine. Importance of nonconventional sources of energy in the present scenario. Brief details of solar energy bioenergy wind energy.

#### 2. Economics of Generation (15 Periods)

2.1 Fixed and running cost load estimation load curves demand factor load factor

diversity factor power factor and their effect on cost of generation simple problems there on

- 2.2 Base load and peak load power stations interconnection of power stations and its advantages concept of regional and national grid
- 2.3 Plant capacity factor plant use factor Daily load curve.

### **3. Transmission Systems (27 Periods)**

- 3.1 Layout of transmission system selection of voltage for H.T. and L.T. lines advantages of high voltage for Transmission of power in both AC and DC
- 3.2 Comparison of different systems: AC versus DC for power transmission conductor material and sizes from standard tables
- 3.3 Constructional features of transmission lines: Types of supports types of insulators Types of conductors Selection of insulators conductors earth wire and their accessories Transposition of conductors and string efficiency of suspension type insulators Bundle Conductors.
- 3.4 Mechanical features of line: Importance of sag calculation of sag effects of wind and ice related problems; Indian electricity rules pertaining to clearance.
- 3.5 Electrical features of line: Calculation of resistance inductance and capacitance without derivation in a.c. transmission line voltage regulation and concept of corona. Effects of corona and remedial measures

### **4. Distribution System (15 Periods)**

- 4.1 Lay out of HT and LT distribution system constructional feature of distribution lines and their erection. LT feeders and service mains; Simple problems on AC radial distribution system determination of size of conductor
- 4.2 Preparation of estimates of HT and LT lines (OH and Cables)
- 4.3 Constructional features of LT (400 V) HT (11 kV) underground cables advantages and disadvantages of underground system with respect to overhead system.
- 4.4 Faults in underground cables determine fault location by Murray Loop Test Varley Loop Test
- 4.5 Transmission and Distribution Losses

### **5. Power Factor (06 Periods)**

- 5.1 Concept of power factor
- 5.2 Reasons and disadvantages of low power factor
- 5.3 Methods for improvement of power factor using capacitor banks Static VAR Compensator (SVC)

### **6. Various types of Tariffs (06 Periods)**

- 6.1 Concept of Tariffs
- 6.2 Block rate flat rate maximum demand and two part tariffs

## LIST OF PRACTICALS

Structured visit to the substations power stations and LT/HT lines student will prepare report and present in a seminar. Evaluation will be based on reports as well as presentation.

## INSTRUCTIONAL STRATEGY

Since this is a descriptive and practice oriented subject it is suggested that visits to different types of power generating stations and substations including grid stations be arranged and various equipment accessories and components explained to the students before the actual class room teaching and make them familiar with the equipment and accessories installed over there. There should be at least 3 visits during the semester. The students may be asked to prepare notes while on visit and submit the report and give seminar. In addition viva voce be conducted to evaluate the knowledge gained during the field visit.

## RECOMMENDED BOOKS

1. Electrical Power System and Analysis by CL Wadhwa 3<sup>rd</sup> edition New Age International Publishers New Delhi
2. Substation Design and Equipment by Satnam and PV Gupta Dhanpat Rai & Sons New Delhi
3. Electrical Power –I by SK Sahdev Uneek Publications Jalandhar
4. Electrical Power System by VK Mehta S Chand and Co. New Delhi
5. Electrical Power System by JB Gupta SK Kataria and Sons New Delhi
6. SubStation Design by Satnam Dhanpat Rai and Co. New Delhi
7. Electrical Power Distribution System by AS Pabla Tata McGraw Hill New Delhi
8. Electrical Power System by S Channi Singh Tata McGraw Publishing Co. New Delhi

## SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	27	30
2	15	15
3	27	30
4	15	15
5	06	05
6	06	05
<b>Total</b>	<b>96</b>	<b>100</b>

## 5.5 PROCESS CONTROL AND INSTRUMENTATION

Periods/ Weeks L P  
6 3

### RATIONALE

The technician has the responsibility of using and maintaining electronic test equipments for measurement design testing and trouble shooting with the introduction of new techniques of process control in modern industries the use of transducing elements in agriculture and other nonengineering areas the task of the technician has become varied and different from the previous task of measurement only. The Course aims to develop appreciation and understanding of the use of measurement of a variety of physical quantities and their control.

### (A) Process Instrumentation

1. Introduction (06 Periods)
  - Functional block diagram of instrumentation system.
  - Description of each block
  - Process
  - Process Characteristics
  - Process Variables
2. Pressure Measurement (09periods)
  - Types of Pressure
  - Measurement of Pressure by Manometers
  - Diaphragms
  - Bourdon Tube
  - Bellows
  - Vacuum Measurement
  - pressure measurement by using strain gauge capacitive transducer and LVDT
3. Temperature Measurement (09 periods)
  - Temperature Measuring Devices Like Thermocouples. . Pyrometer
  - Resistance Thermometer.
  - Thermister
  - Bimetallic Thermometer
  - Temperature measurement by using RTD Thermister Bolo meter
4. Strain Measurement (08 periods)
  - Requirements for strain measurement
  - Strain Gauges
  - General Strain Measurement
  - Load cell
5. Vibration and Angular Velocity Measurement (08 Periods)
  - Vibration Measurement Systems

- Measurement of Angular Velocity
- DC & AC Tachometer Generators
- Digital Methods

## 6. Medical Instruments

(08periods )

- General idea and working and application of Medical Instruments
- X Ray Machine
- Electronic method for
- BP measurement
- Blood Sugar measurement
- EEG and
- ECC machine

## 7Flow Measurement

(08 Periods)

- General Types of Flow
- Flow Coefficient
- Reynolds No
- Flow Meters
- Venturi Meter
- Orifice Plate
- Pitot Tube
- Rotameter

## (B) Process Control

### 8. Introduction

(12 periods)

- Basic element of control system - control system terminology
- Block diagram of a general open and closed loop process
- Automatic Control system
- Control System Components
- Brief description and working of a potentiometer
- Differential transformer servo motors
- Tacho Generator
- Eddy Current clutches relay contractors timing relay

### 9. Types of Control Techniques

(12 Periods)

- Brief Idea and Introduction of following control techniques
- ONOFF Control
- Proportional
- Integral
- Derivative
- PI
- PD

- PID

## 10. Controllers

(16periods)

- Block Diagram & Circuits of pneumatic PIPD & PID controller ONOFF Controller
- Electronic Controller/Automatic Controller
- Simple Example Of
- Heating Control using SCR
- Illumination Control
- Level Control
- Pressure Control

## LIST OF PRACTICALS

1. Experiment of Pressure Measurement
2. Experiment of Temperature Measurement
3. Experiment of Flow Measurement
4. Experiment of Moisture/Humidity Measurement
5. Experiment of Strain Measurement/ load cell
6. Measurement of PH value
7. Measurement of angular velocity
8. ON /OFF Controller
9. Experiment of Basic Control Action (PIDPID Controller)

## RECOMMENDED BOOKS

1. Instrumentation Devices & Systems by By S. Ranjan; Tata McGrawHill Publishing
2. Electrical & Electronics Measurement by A. K. Sawhney; Danpat Rai & Co.
3. Industrial Instrumentation by Tyson
4. Process Instrumentation by Donald P. Echman
5. Process Control by Donald P. Echman
6. Instrumentation by Cirk & Rimboi
7. Instrumentation Measurement and Analysis by B. C. Nakra and K K Chaudhary; MC Graw Hill Publication.

Topic	Time Allotted (Periods)	Marks Allocation (%)
1	6	6
2	9	10
3	9	10
4	8	10
5	8	10
6	8	08

7	8	08
8	12	10
9	12	15
10	16	15
<b>Total</b>	<b>96</b>	<b>100</b>

SUGGESTION