MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES

COURSE NAME : DIPLOMA IN ELECTRICAL POWER SYSTEM

COURSE CODE : EP

DURATION OF COURSE : SIX SEMESTERS **WITH EFFECT FROM 2012-13**

SEMESTER : SIXTH **DURATION : 16 WEEKS**

PATTERN : FULL TIME - SEMESTER **SCHEME : G**

SR. NO	SUBJECT TITLE	abbreviation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME									SW (17600)
							PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)		
				TH	TU	PR		Max	Min	Max	Min	Max	Min	Max	Min	
1	Management $	MAN	17601	03	--	--	1&½	50#*	20	--	--	--	--	--	--	
2	Testing & Maintenance of Electrical Equipments β	TME	17637	04	--	04	03	100	40	50#	20	--	--	25@	10	
3	Power Electronics β	PEL	17638	04	--	02	03	100	40	50#	20	--	--	25@	10	
4	Power System Operation & Control	PSO	17643	03	--	02	03	100	40	--	--	--	--	25@	10	50
5	**Elective (Any One)**															
	Power Quality	EIA	17644	04	--	02	03	100	40	--	--	--	--	25@	10	
	Renewable Energy Sources	BCS	17645	04	--	02	03	100	40	--	--	--	--	25@	10	
6	Project β	PRO	17801	--	--	04	--	--	--	--	--	50#	20	50@	20	
			Total	**18**	**--**	**14**	**--**	**450**	**--**	**100**	**--**	**50**	**--**	**150**	**--**	**50**

Student Contact Hours Per Week: **32 Hrs.**

THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.

Total Marks **: 800**

@ - Internal Assessment, # - External Assessment, ▭ No Theory Examination, $ - Common to all branches, #*- Online Examination, β - Common to EE

Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work.

- Conduct two class tests each of 25 marks for each theory subject. Sum of the total test marks of all subjects is to be converted out of 50 marks as sessional work (SW).
- Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms.
- Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.

Course Name : All Branches of Diploma in Engineering / Technology

Course Code : EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/CO/CM/IF/ CW/EE/EP/EU/CH/CT/PS/CD/ED/EI/CV/FE/IU/MH/MI/TX/TC/FG

Semester : Sixth for EJ/EN/ET/EX/EV/IC/IE/IS/MU/DE/ME/PG/PT/AE/CE/CS/CR/ CO/CM/IF/CW/EE/EP/EU/CH/CT/PS/TX/TC/FG and Seventh for MH/MI/CD/ED/EI/ CV/FE/IU

Subject Title : Management

Subject Code : 17601

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	--	1&½	50#*	--	--	--	50

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Management concepts are universal and it is a multidisciplinary subject. They are equally applicable to different types industries like Manufacturing, Service and Trade as well as different kind of business activities like industry, army, school, hospital, retail shops etc. Also, at the end of diploma course polytechnic students are expected to enter in to the Industrial Environment. This environment is altogether different and new to the students. A proper introduction and understanding of management fundamentals is therefore essential for all these students.

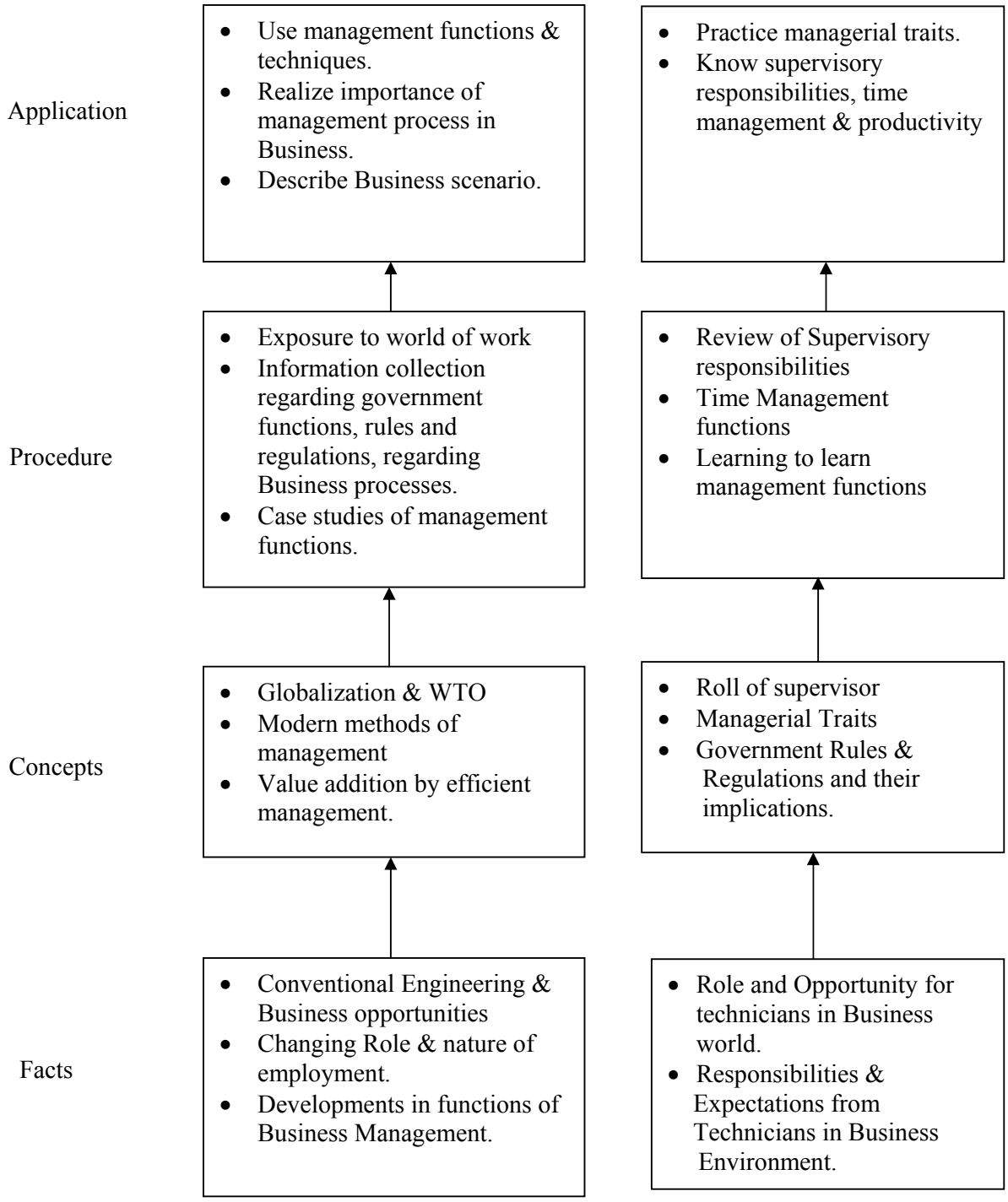
Contents of the this subject will enable the students to address various issues related to human resource, finance, materials, legislations etc. by use of basic principles of management. This will ensure that students will play their role effectively to enhance the quality of business output in total.

Objective:

The students will able to:

1. Get familiarized with environment related to business processes.
2. Know the management aspects of the organisations.
3. Understand Role & Responsibilities of a Diploma engineer.
4. Understand importance of quality improvement techniques.
5. Appreciate need and importance of safety in industries.
6. Understand process of Industrial finance and its management.
7. Know the latest trends in industrial management.

Learning Structure:



Contents: Theory

Topic and Contents	Hours	Marks
Topic 1: Overview of Business **Specific Objectives** ➢ State various business types and sectors ➢ Describe importance of globalisation 1.1. Types of Business • Service • Manufacturing • Trade 1.2. Industrial sectors Introduction to • Engineering industry • Process industry • Textile industry • Chemical industry • Agro industry • IT industry • Banking, Insurance, Retail, Hospitality, Health Care 1.3 Globalization • Introduction • Advantages & disadvantages with respect to India	02	04
Topic 2: Management Process **Specific Objectives** ➢ State various management principles ➢ Describe different management functions 2.1 What is Management? • Evolution • Various definitions of management • Concept of management • Levels of management • Administration & management • Scientific management by F.W.Taylor 2.2 Principles of Management (14 principles of Henry Fayol) 2.3 Functions of Management • Planning • Organizing • Directing • Controlling • Decision Making	08	08
Topic 3: Organisational Management **Specific Objectives** ➢ Compare different forms of organisation , ownership for a specific business ➢ Describe types of departmentation 3.1 Organization : • Definition	08	08

• Steps in organization 3.2 Types of organization • Line • Line & staff • Functional • Project 3.3 Departmentation • By product • By process • By function 3.4 Principles of Organisation • Authority & Responsibility • Span of Control • Effective Delegation • Balance ,stability and flexibility • Communication 3.5 Forms of ownership • Proprietorship • Partnership • Joint stock • Co-operative Society • Govt. Sector		
Topic 4: Industrial Safety and Legislative Acts **Specific Objectives** ➢ Describe types of accidents & safety measures ➢ State provisions of industrial acts. 4.1 Safety Management • Causes of accidents • Types of Industrial Accidents • Preventive measures • Safety procedures 4.2 Industrial Legislation - Necessity of Acts Important Definitions & Main Provisions of following acts: • Indian Factory Act • Workman Compensation Act • Minimum Wages Act	08	06
Topic 5: Financial Management (No Numerical) **Specific Objectives** ➢ Explain functions of financial management ➢ State the sources of finance & types of budgets. ➢ Describe concepts of direct & indirect taxes. 5.1 Financial Management- Objectives & Functions 5.2 Capital Generation & Management • Types of Capitals - Fixed & Working • Sources of raising Capital - Features of Short term, Medium Term & Long Term Sources 5.3 Budgets and accounts • Types of Budgets	08	08

• Fixed & Variable Budget - Concept • Production Budget - Sample format • Labour Budget - Sample format • Profit & Loss Account & Balance Sheet - Meaning, sample format, meaning of different terms involved. 5.4 Meaning & Examples of - • Excise Tax • Service Tax • Income Tax • Value Added Tax • Custom Duty		
Topic 6: Materials Management (No Numerical) **Specific Objectives** ➢ Describe concept of inventory, ABC analysis & EOQ. ➢ Describe purchase functions & procedures ➢ State features of ERP & MRP 6.1. Inventory Concept, its classification, functions of inventory 6.2 ABC Analysis - Necessity & Steps 6.3 Economic Order Quantity Concept, graphical representation, determination of EOQ 6.4 Standard steps in Purchasing 6.5 Modern Techniques of Material Management • Material Resource Planning (MRP) - Functions of MRP, Input to MRP, Benefits of MRP • Enterprise Resource Planning (ERP) - Concept, list of modules, advantages & disadvantages of ERP	08	08
Topic 7 Quality Management **Specific Objectives** ➢ State Principles of Quality Management ➢ Describe Modern Technique & Systems of Quality Management 7.1 Meaning of Quality Quality Management System – Activities, Benefits Quality Control - Objectives, Functions, Advantages Quality Circle - Concept, Characteristics & Objectives Quality Assurance – Concept, Quality Assurance System 7.2 Meaning of Total Quality and TQM Components of TQM – Concept, Elements of TQM, Benefits Marks 04 7.3 Modern Technique & Systems of Quality Management like Kaizen,5'S',6 Sigma 7.4 ISO 9001:2000 - Benefits, Main clauses.	06	08
Total	**48**	**50**

Learning Resources:
Books:

Sr. No	Author	Name of Book	Publisher
01	Dr. O.P. Khanna	Industrial Engineering & Management	Dhanpat Rai & Sons New Delhi
02	Banga & Sharma	Industrial Engineering & Management	Khanna Publication
03	Dr. S.C. Saksena	Business Administration & Management	Sahitya Bhavan Agra
04	W.H. Newman E. Kirby Warren Andrew R. McGill	The process of Management	Prentice- Hall

E Source:

nptel.iitm.ac.in
http://iete-elan.ac.in/subjects/amIndustrialMgmt.htm

Course Name : Electrical Engineering Group

Course Code : EE / EP

Semester : Sixth

Subject Title : Testing and Maintenance of Electrical Equipments

Subject Code : 17637

Teaching and Examination Scheme

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	04	03	100	50#	--	25@	175

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

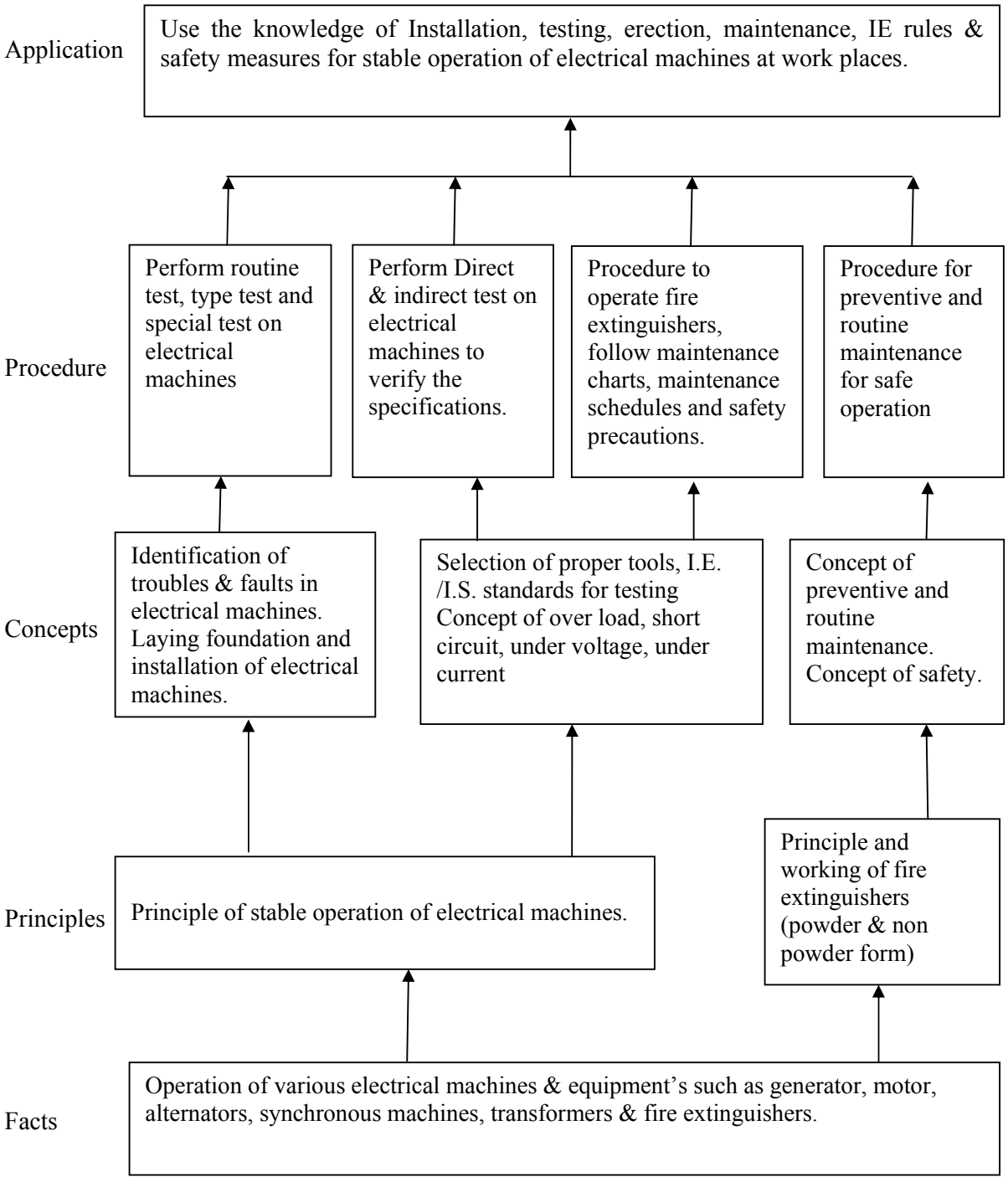
This course is under applied technology courses. Most of the diploma electrical engineers are working either in industries, power plants or in state electricity board as a supervisor / technician/procurement engineer. They have to understand instructions from superiors and pass on the same to the skilled workers working under them. The knowledge of testing, maintenance, erection and installation of electrical equipment's in industries, power plants and state electricity board is essential. This subject provides the detailed guidelines as per I.S. codes/I.E. Rules for testing, maintenance, erection and installation of electrical equipment's. As scope of business/Industry is at global level it is also essential that the student should be well conversed about international codes. They should be made aware about importance of preventive maintenance for efficient and effective functioning of electrical machines.

General Objectives:

After completing this course students will be able to-

1. Know I.S. codes/I.E. Rules & safety measures related to electrical machines.
2. Identify / Locate common troubles in electrical machines.
3. Plan & carry out routine & preventive maintenance
4. Prepare trouble-shooting charts for electrical machines.
5. Ascertain the condition of insulation & revarnishing if necessary.
6. Initiate total productive maintenance.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Safety Measures & Prevention of Accidents Specific Objectives: ➢ To follow electrical safety measures ➢ To rescue electrocuted person and follow artificial respiration methods ➢ To use fire extinguisher for fire due electrical causes Contents: 1.1 Concept of electrical safety, electrical accidents, its causes & preventions. 1.2 Safety signs and symbols used in industry. 1.3 Electrical shocks and factors affecting the severity of it, method of rescuing electrocuted person & different methods of artificial respiration. 1.4 Electrical safety as per I.E. Rules 1956. 1.5 Do's & don'ts regarding safety while working on electrical installations. 1.6 Concept of Permit system, its preparation & regulation for attending to electrical work. 1.7 Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers, types of fire extinguishers.	08	12
Topic 2: Testing of Electrical Machines Specific Objectives: ➢ To perform tests on various electrical machines as per Indian Standards Contents: 2.1 Objectives of testing. 2.2 Roles of Bureau of Indian Standards (BIS) in testing of electrical equipment's. 2.3 Types of tests: Routine, type, supplementary & special tests. 2.4 Methods of testing - Direct/ Indirect/ Regenerative testing. 2.5 Concepts of tolerances. • Tolerances for rotating machines as per IS 4722-2001 • Tolerances for power transformers as per IS 2026 (part-I) - 2011 2.6 Testing of transformer as per IS 2026 (Part-I)-2011 • Routine tests, Type tests and Special tests. 2.7 Testing of three-phase Induction motor as per IS 4029 - 2010 and IS 325 - 1996. • I.M. as a generalized transformer with vector diagram • Equivalent circuit of 3-phase IM (No numerical) • performance of open circuit test and short circuit (blocked rotor) test to find various quantities by drawing circle diagram with various conditions such as • at full load • maximum torque • maximum output • maximum input 2.8 Numericals on 2.6 & 2.7. 2.9 Testing of single-phase induction motor as per IS 7572-2009. 2.10 Testing of synchronous machines as per IS 7132-1973.	22	32

Topic 3: Maintenance of Electrical Machines Specific Objectives: ➢ To plan routine and preventive maintenance schedule ➢ To prepare maintenance schedules for electrical equipments as per IS ➢ To identify different faults developed due to poor maintenance of electrical machines Contents: 3.1 Concept of maintenance, types of maintenance, Routine, preventive & breakdown maintenance. 3.2 Causes of failure of electrical machines. 3.3 Preventive maintenance • Advantages • Procedure for developing preventive maintenance schedules for electrical machines 3.4 Factors affecting preventive maintenance schedules. 3.5 Identification of different types of faults developed such as mechanical, electrical and magnetic faults due to poor maintenance. 3.6 Maintenance schedules of the following as per I.S.S. • Distribution transformer and Power transformer as per IS 10028 (Part-III)-1981 • Single phase & three phase Induction motors as per IS 900-1992 • Synchronous machines • Batteries IS 14782-2000	10	12
Topic 4: Testing and Reconditioning of Insulating Materials Specific Objectives: ➢ To follow the methods of reconditioning of insulation ➢ To test insulating oil as per IS ➢ To measure insulation resistance by different methods Contents: 4.1 Factors affecting life of insulating materials, classifications of insulating materials as per IS 1271-1985. 4.2 Measuring insulation resistance by different methods such as i) Polarization, ii) Dielectric absorption, iii) Megger • To predict the condition of insulation • Meaning of infinity and zero reading 4.3 Reconditioning of insulation • Cleaning and drying the insulation • Re-varnishing • Construction and working of vacuum impregnation plant 4.4 Insulating oil • Properties of insulating oil • Causes of deterioration of oil • Testing of transformer oil as per IS 1866-2000 • Method of purification and filtration of insulating oil	08	16
Topic 5: Fault Finding and Troubleshooting of Electrical Machines Specific Objectives: ➢ To use various tools for fault finding in electrical machines ➢ To locate faults in electrical machines ➢ To prepare trouble shooting charts for rotating machines and	08	12

transformers Contents: 5.1 Limits of voltage, current, frequency & speed for safe working of electrical machines. 5.2 Internal & external causes for failure and abnormal operation of equipments. 5.3 List of mechanical faults, electrical faults & magnetic faults in the electrical equipments. 5.4 Use of tools like bearing puller, filler gauges, dial test indicator, spirit level, megger, earth tester, and growler. 5.5 Common troubles in electrical equipments and machines. Preparation of trouble shooting charts for • D.C. Machines • AC Machines • Transformers [IS 10028 (Part-III) - 1981]		
Topic 6: Installation and Earthing of Electrical Machines Specific Objectives: ➢ To install static and rotating electrical machines ➢ To use the devices and tools for handling of electrical equipments ➢ To level and align different coupled drives ➢ To reduce the resistance of earth electrode by different methods Contents: 6.1 Concept of foundation for machinery installation. Requirements of foundation for static & rotating electrical machinery. 6.2 Concept and procedure of leveling & aligning. • Alignment of direct coupled drive • Effects of misalignment 6.3 Installation of transformer as per IS 10028 (part-II) -1981. 6.4 Requirements of installation of pole mounted transformer. 6.5 Requirements of installation of rotating electrical machines as per IS 900 – 1965 6.6 Devices and tools required for loading, unloading, lifting, and carrying heavy electrical equipment's & precautions to be taken while handling them. 6.7 Earthing • Importance of earthing • Difference between installation earthing & system grounding • Types of earthing as per IS 3043 - 1987 • Earthing resistance values for different types of installations • Factors affecting earth resistance • Methods of reducing earth resistance • Provision of earthing as per I.E. rule-61 & I.E.rule-90	08	16
Total	**64**	**100**

Practical:
Skills to be developed:

Intellectual Skills: 1. Select appropriate meters and equipment.
2. Recollect testing and maintenance procedures.

Motor Skills: 1. Accuracy of measurement.
2. Proper connections.
3. Draw characteristics.

List of Practicals:

Sr. No.	Title of Practical/Lab.Work/Assignments
1	Measure Impedance, Voltage and Load losses of Three phase Transformer.
2	Perform reduced voltage running up test on Three Phase Induction Motor as per IS 325:1967.
3	Perform No Load and Blocked Rotor Test on Three Phase Induction Motor as per IS 325:1967. And Draw Circle diagram and Calculate performance Indicator.
4	Calculate Regulation and Efficiency bye Back to Back connection of single phase Transformer.
5	Determine Breakdown Strength of Transformer Oil by using Oil Testing Kit.
6	Measure Insulation resistance of Transformer winding , Stator and Rotor of A.C. Rotating Machines using Megger.
7	Measure the Resistance of Earth Electrode using Earth Tester.
8	Understand the operation of Fire Extinguisher by giving Demonstration.
9	Prepare Troubleshooting Charts for Single Phase and Three Phase Induction Motor
10	Use different maintenance tools such as Bearing Puller, Growler, Dial-Test Indicators, Filler Gauge, Spirit Level, etc.

List of Assignments:

1. To demonstrate artificial respiration methods for shock affected persons.
2. To visit transformer repairing workshop/ electrical machine workshop.

Learning Resources:

1. Books:

Sr. No.	Author	Title	Publisher
1.	B.V.S. Rao	Operation & Maintenance of Electrical Equipments Vol-I & II	Media promoters and publisher Ltd. Mumbai
2.	M.V. Deshpande	Design & Testing of Electrical Machines	PHI learning private Ltd. New Delhi
3.	Sunil S. Rao	Switchgear & Protection	Dhanpat Rai and Sons, New Delhi
4.	Bhattacharya	Electrical Machines	Tata McGraw Hill
5.	V.K. Mehata & Rohit Mehata	Principles of Electrical Machines	S. Chand & Company Ltd.
6.	Tarnekar & Kharbanda	Laboratory Experiments in Electrical Engineering.	S. Chand & Company Ltd.
7.	B. L.Theraja	A Textbook of Electrical Technology Vol.-II	S. Chand & Company Ltd.
8.	Edward Hughes	Electrical and Electronics Technology	ELBS publications
9.	Kothari & Nagrath	Electrical Machines	Tata McGraw Hill

2. **CDs, PPTs, Models, Charts etc. :**
   PPTs:
   - www.lanl.gov/safety/electrical/docs/skilled_worker_module_6.ppt
   - www.sandia.gov/.../Electrical/Sand_2009_1947_P_Non-Electrical

3. **IS Codes and I.E Rules:**

I.E. Rules 1956	: Safety
IS 4722-2001	: Rotating Electrical Machines – Specification
IS 2026 (part-I) -2011	: Power transformers: Part 1 General
IS 2026 (Part-II)-2010	: Power transformers: Part 2 Temperature-rise
IS 2026 (Part-III)-2009	: Power Transformers: Part 3 Insulation Level, Dielectric Tests and External Clearances in Air
IS 2026 (Part-IV)-1977	: Power transformers: Part 4 Terminal marking, tappings and Connections
IS 4029 – 2010	: Guide for testing three-phase induction motors
IS 325-1996	: Three phase Induction motors- specifications
IS 7572-1974	: Guide for testing single-phase ac and universal electric motors
IS 7132-1973	: Guide for testing synchronous machines
IS 10028 (Part-III)-1981	: Code of practice for selection, installation and maintenance of transformers: Part 3 Maintenance
IS 900-1992	: Code of practice for installation and maintenance of induction motors (first revision)
IS 1271-1985	: Thermal evaluation and classification of electrical insulations
IS 1866-2000	: Code of practice for electrical maintenance and supervision of mineral insulating oil in equipment
IS 3043 – 1987	: Code of practice for earthing
IS 15429-2004	: Storage installation and maintenance of dc motors-code of Practice
IS 9320-1979	: Guide for testing d.c. machines
IS 14782-2000	: Code of Practice for Maintenance and Testing of Large Lead acid Batteries for Generating Stations and Substations
I.E. rule-61	: Earthing
I.E.rule-90	: Earthing

4. **Websites:**
   - www.bis.org.in
   - www.standardsbis.in
   - www.civilengineer.co.in

Course Name : Electrical Engineering Group

Course Code : EE/EP

Semester : Sixth

Subject Title : Power Electronics

Subject Code : 17638

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	50#	--	25@	175

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Power electronics is a branch of engineering that combines the fields of electrical power, electronics and control. As an electrical engineer it is necessary to exercise control on power given to the machines to control its speed, voltage and current to suit its load.

The invention of thyristor as a power device led to development of compact, reliable and maintenance free drive circuits. The utility of power devices spread to industrial applications such as UPS, induction heating, high voltage DC transmission, Electrical welding etc.

Microprocessors and microcomputers have made their impact on power electronics based industrial equipment. Their application for control of electric devices is used as a brain and the power semiconductors are considered as muscles of the equipment.

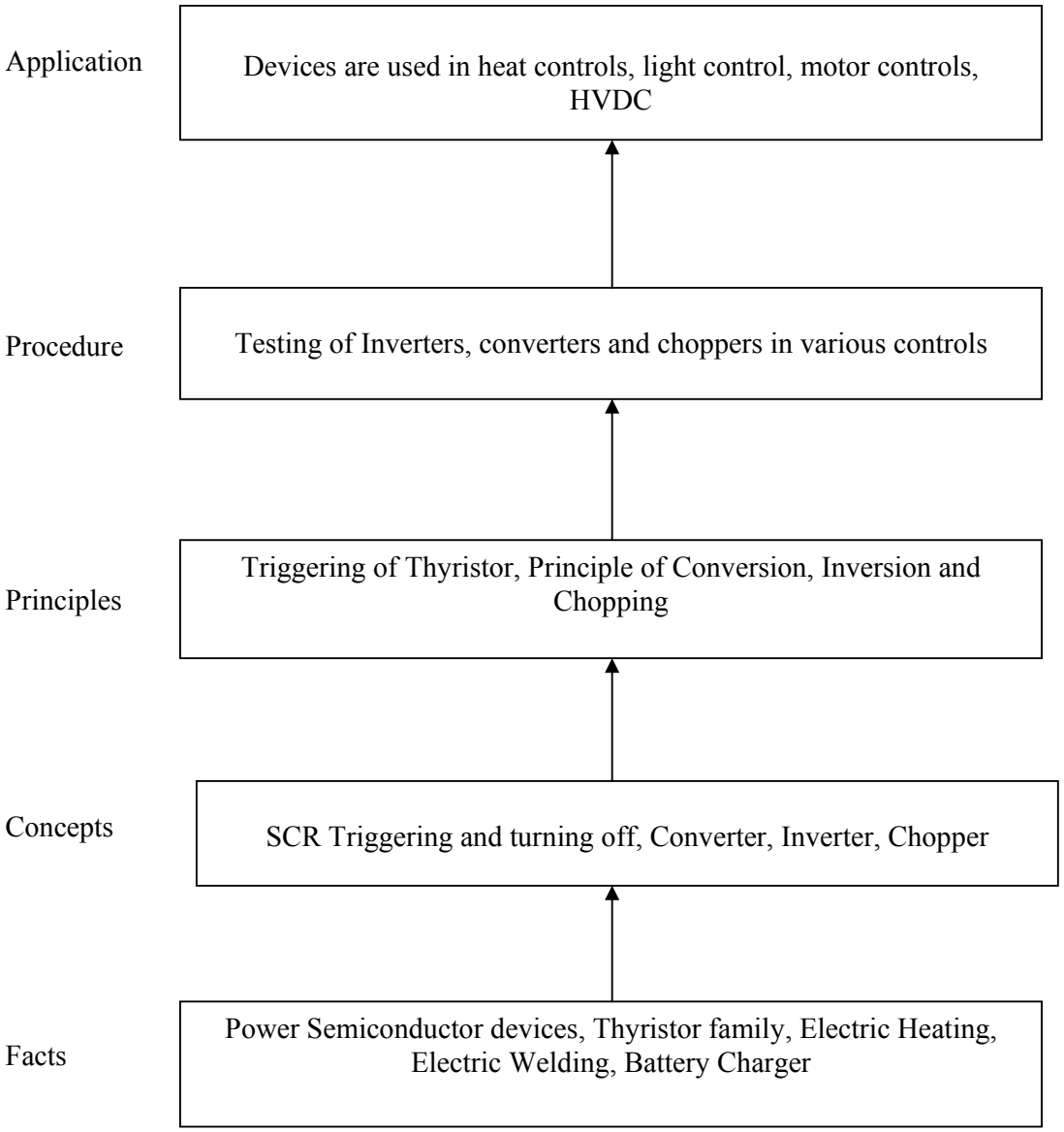
With rapid development in modern technology, power electronic equipments are integral part of control system.

General Objectives:

The students will be able to:

1. Understand the physical processes for the switching of a thyristor.
2. Know the various methods of triggering a thyristor and different gate turn-on methods.
3. Develop logic about the turning off mechanism of a thyristor and get acquainted with some methods of turning a thyristor off.
4. Become familiar with other members of the thyristor family as well as other power electronic devices.
5. Know the characteristics of different power electronic devices.
6. Know the working of rectifiers, choppers, inverters and industrial applications of the thyristor.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction to Power Electronics **Specific Objectives:** ➢ State purpose of power conversion. ➢ List application areas of Power Electronics. ➢ Select specific Thyristor device for required application. **Contents:** • Necessity of Power conversion using solid state devices • Applications of Power Electronics • Thyristor family ❖ Characteristics and symbolic representation of SCR, DIAC, TRIAC, GTO, SUS, LASCR, IGBT. • SCR: Construction, operation, Two transistor analogy • Triggering methods of SCR ❖ Voltage triggering. ❖ dv/dt triggering. ❖ Light triggering. ❖ Gate triggering ✓DC gate triggering ✓AC gate triggering. ✓Pulse gate triggering. • SCR Turn-off process with waveforms of Voltage and Current • SCR Specifications/Ratings: Voltage , Current , Power , Temperature • SCR selection factors • SCR testing	10	20
Topic 2 : Converters **Specific Objectives:** ➢ Operation of controlled converters ➢ Classification of Controlled converters. ➢ Identify different types of converters for required applications **Contents:** • Necessity of Convertors • Concept of firing angle and conduction angle • Single phase fully controlled half wave converter - With resistive load - RL load without freewheeling diode. - RL load with freewheeling diode. • Single phase full wave controlled converter - With resistive load - With RL load • Single phase fully controlled bridge converter - With resistive load - With RL load • Three phase fully controlled bridge converter - With R load • Comparison of 3Ø and 1Ø converters on the basis of efficiency, ripple factor , RMS Values and average values	12	20

• Effect of source impedance on converter operation. • Cycloconverters: 1Ø - Principle of operation, input and output waveforms.		
Topic 3 : Inverters **Specific Objectives:** ➢ List different types of inverters and applications. ➢ Selection of 1Ø or 3Ø inverters for required application. **Contents:** • Need of Inverter • Classification : - 1Ø and 3Ø inverters. - Line (Natural) commutated Inverters - Forced commutated inverters: Series, parallel and bridge inverters.(circuit, description and waveforms) • Series inverters: Operation of basic series inverter , Modified series inverter, Three phase series inverter. • Parallel inverters: Operation of basic parallel inverter circuit. • Single Phase Bridge Inverter - Half bridge inverter - Full bridge inverter • Voltage and frequency control of 1Ø inverter - Necessity of control of output voltage. - Methods for output voltage control: External control of DC voltage, External control of AC voltage and internal control. - Pulse width modulation (PWM) method: Single pulse width modulation, multiple pulse width modulation, Sinusoidal pulse width modulation. • Waveform control (Harmonic Reduction): Single pulse width modulation, transformer connections, using filter (LC, Resonant) • Concept of MOSFET Inverter and comparison with thyristor based inverter	14	20
Topic 4 : Choppers **Specific Objectives:** ➢ Necessity of chopper. ➢ Selection of chopper as per the requirement of application. **Contents:** • Chopper principle • Control techniques: Constant Frequency System, Variable Frequency System. • Classification of choppers :Class A, class B, class C, class D, class E • Commutation methods for choppers: Auxiliary commutation, load commutation. • Jones chopper • Step up chopper.	10	16
Topic 5 : Applications of Power Electronics **Specific Objectives:** ➢ State basic principles of AC and DC Machines. ➢ Selection of SCR control circuit as per the requirement of application. **Contents:** 5.1 DC Drives • Speed control of DC series motor with 1Ø half and full control	18	16

converter, step up and step down chopper 5.2 AC Drives • Speed control of 3Ø induction motor - Variable frequency control : Voltage source inverter, current source inverter, cycloconverter • Other applications: Circuit diagram, operation - Static circuit breaker(DC and AC) - Induction heating control - Dielectric heating control - Electric welding control - Battery charger control - Automatic street lighting circuit using SCR - Static VAR compensation system - Close loop speed control method for D C and AC servo moto		08
Total	**64**	**100**

Practical:
Skills to be developed:

- **Intellectual Skills**
  1. Select appropriate circuits and instruments
  2. Testing and troubleshooting
- **Motor Skills**
  1. Accuracy of measurement
  2. Proper connection
  3. Draw characteristics

List of Practical:

1. Plot V-I charactristics of SCR and find latching current (IL), holding current (IH) and the forward break over voltage (VFBO).
2. Observe the output waveforms of single phase full wave controlled rectifier with resistive load, inductive load with and without freewheeling diode. Measure the load voltage with variations in firing angle.
3. Observe the output waveform of three phase full wave controlled rectifier with resistive load, inductive load without and with freewheeling diode. .
4. Understand single phase series inverter and to measure the output signal resonance frequency and voltage.
5. Understand current commutated step down chopper and observe the change in output voltage.
6. Understand operation of battery charger using SCR and observe change in charging voltage and current.
7. Understand the speed control of DC series motor using SCR phase control and plot speed Vs. armature voltage characteristics.
8. Understand the speed control of three phase induction motor using PWM inverter and plot speed Vs. torque characteristics.
9. Visit to traction system/coal handling in thermal power station/process industry/oil extraction plant or any other similar industry and prepare a report .Deliver seminar on the small topic related to visit or any other topic allotted by the teacher.

Learning Resources:
Books:

Sr. No.	Author	Title	Publisher
1	M. D. Singh K. B. Khanchnadani	Power Electronics	Tata Mcgraw Hill
2	S. K. Bhatacharya S. Chattarjee Ttti Chandigad	Industrial Electronics & control	Tata Mcgraw Hill
3	P. C. Sen	Power Electronics	Tata Mcgraw Hill
4	M. D. Rashid	Power Electronics	Pearson
5	V. R. Moorthi	Power Electronics	OXFORD
6	Mohan, Undeland Riobbins	Power Electronics	Willey Student Edition
7	S. K. Bhatacharya	Fundamentals of Power Electronics	Vikas Publication
8	V. Jagannathan	Power Electronics Devices & Circuits	PHI
9	--	SCR Manual	General Electric Co.

Websites:

- freevideolectures.com/Course/2351/Power-Electronics
- freevideolectures.com/.../Industrial-Drives-and-Power-...
- www.learnerstv.com/Free-Engineering-Video-lectures-ltv127
- www.circuitstoday.com/scr-characteristics
- en.wikipedia.org/wiki/Thyristor
- www.freepatentsonline.com/5216683.html
- en.wikipedia.org/wiki/Inverter_(electrical)

Course Name : Diploma in Electrical Power System

Course Code : EP

Semester : Sixth

Subject Title : Power System Operation & Control

Subject Code : 17643

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work. (SW)**

Rationale:

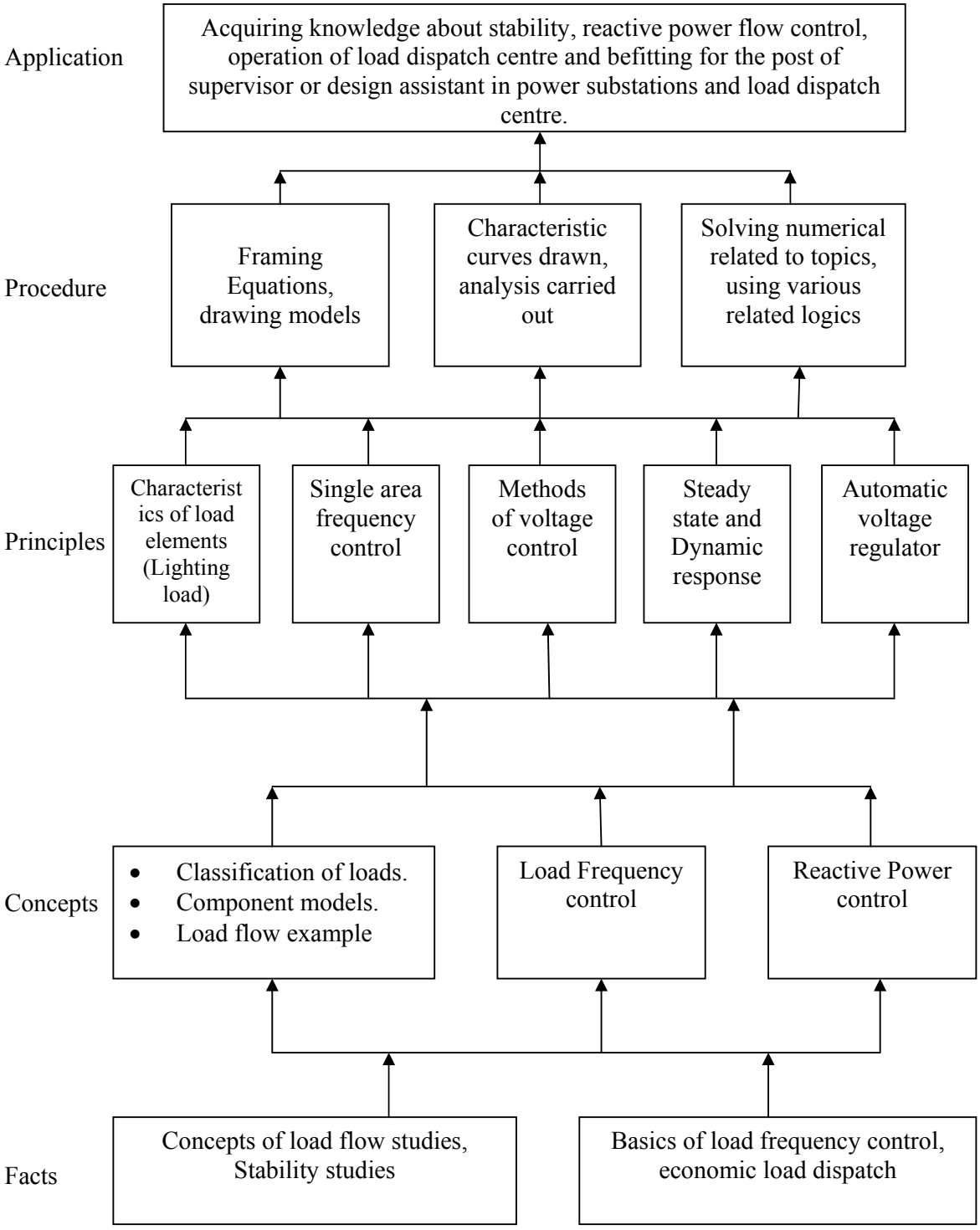
Electrical power system is an advanced, sophisticated and highly significant field in an Electrical engineering course. Knowledge about the operation, control and stability of power systems, load flow and dispatching, reactive power control etc. will be required for effective power system operation and control.

The topics on real and reactive power flow control, effect of change in frequency and excitation, reactive power compensation, steady state and transient state stability, load forecasting, Automatic Generation Control (AGC) and voltage control, solving numerical related to three bus system and deriving static load flow equation etc. are vital to learn and understand about the field of operation and control of power system. The student will be able to join as a supervisor or an assistant in design of power control equipments of substations and receiving stations.

General Objectives:

1. Understand the basics of power system operating principles and controls.
2. Understand how to obtain optimum performance of the existing power system.
3. Know various power system controls such as excitation and voltage control, automatic generation control, VAR flow and its compensation methods etc.
4. Understand economic operation of power system, develop the ability to analyze the load curve and make forecast of the loads based on load curve.
5. Know to form Y bus and solve numerical for a three bus system.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Concept of Complex Power Flow (Real and Reactive Power) in Power System. **Specific Objectives:** ➢ Interpret relation between real power and frequency / Reactive power and voltage ➢ Use methods of compensation for reactive power control **Contents:** 1.1Concept and significance of bus, classification 1.2 Concept of Real power flow in Power System. 1.3 Relation between Real power and frequency of the system. • Derive relation for a simple two bus system. • Effect of change in frequency on various consumers and Utilities. 1.4 Relation between Reactive power and voltage of the system. • Effect of change in voltage • Concept of reactive power compensation ▪ Load and line compensation. • Types of Compensation (method of providing compensation and explanation and advantages). ▪ Shunt compensation ▪ Series compensation ▪ Synchronous Compensation (No numerical on the above topic)	08	16
Topic 2: Load Flow Studies **Specific Objectives:** ➢ Develop static load flow equation for a two bus system and learn about load flow studies. ➢ Formation of Y bus. **Contents:** 2.1 Need of load flow analysis • Data required for load flow studies • Derivation of static load flow equation (S.L.F.E) for simple two bus system. • Information obtained from load flow studies. 2.2 Formation of Y bus. • Power system equations ▪ Bus loading and line flow equations. ▪ SLFE in general form • Numericals for 3 bus system including reference bus	05 05	12 12
Topic 3: Power System Stability **Specific Objectives:** ➢ Derive the maximum power flow and the steady state condition. ➢ Use of swing equation and Power angle curve for study of stability of a given system ➢ Select methods of improving transient stability.		

Contents: 3.1Definition and illustration of terms: ▪ Power system stability and instability. ▪ Stability limit ▪ Transient stability and its limit ▪ Steady state stability and its limit. ▪ Dynamic state stability. ▪ Overall stability. • A simple two machine power system for stability studies. (Model, concept and complete explanation). • Adverse effects of instability 3.2 Swing equation (no derivation) and the significance of power angle. • Transient stability. ▪ Factors affecting transient stability ▪ Methods of improving transient stability. • Steady state stability ▪ Derivation of maximum power flow under steady state condition. (No numerical on the above topic)	04 06	08 12
Topic 4: Automatic Generation and Voltage Control **Specific Objectives:** ➢ To describe the method followed for control of load frequency of a turbine speed governing system. ➢ To learn about the methods of control of voltage of a synchronous generator. **Contents:** 4.1 Schematic diagram of load frequency and excitation voltage regulators of a turbo generator and describe the function of each block • Load frequency control (single area case) ▪ Turbine speed governing system. • Automatic voltage control ▪ Schematic diagram of alternator voltage regulator scheme and its explanation. • The automatic load frequency and voltage regulator control loops of a synchronous generator and its explanation and advantages. 4.2 Methods of voltage control • Reactive power injection. • Control by transformers (Explain in detail). (No numerical on the above topic)	08 02	16 04
Topic 5 : Load Dispatching **Specific Objectives:** ➢ Work as assistant engineer in LDC. ➢ Assist in deciding economic and optimum load dispatch. **Contents:** 5.1 Load forecasting • Need of forecasting. • Forecasting based on load curve. • Environmental and social factors in load forecasting. • Planning tools	06	12

5.2 Load shedding and its governing factors 5.3 Functions of load dispatch centre. 5.4 Types of LDC and their significance. 5.5 Economic and Optimum load dispatch • Input output curve • Incremental fuel rate • Incremental efficiency • Economic dispatch neglecting losses. • Optimum load dispatch including transmission losses (Simple numerical on economic dispatch neglecting losses.)	04	08
Total	**48**	**100**

Practicals:
Skills to be developed:

Intellectual Skills:

1. Understand the concept of real and reactive power
2. Collection of data about load flow studies.
3. Identify and understand reactive power compensating equipments.

Motor Skills:

1. To carry out the simulation of a system. (Frequency Control and Voltage Control) using MATLAB.
2. Drawing the various power system control equipments.

List of Practicals:

1. Develop a MATLAB program for analysis of two bus system model.
2. Understand different methods of reactive power compensation for improvement of power factor
3. Develop a MATLAB program to form admittance matrix of a three bus system.
4. Develop a SIMULINK Model of a turbine speed governing system of a turbo generator and record the effect of change in speed on frequency.
5. Develop a SIMULINK model of automatic voltage regulator for a synchronous generator and record the effect of change in excitation on generated voltage.
6. Develop a MATLAB program on Economic load dispatch neglecting losses.
7. Visit a generating/co-generation/ load dispatch station and make report on different controls used for frequency and voltage
8. Visit a nearby industry/ station and prepare a report on reactive power compensation equipment used.

Learning Resources:
Books:

Sr. No.	Author	Title	Publisher
1	I. J. Nagrath D. P. Kothari	Modern Power System Analysis (IV th Edition)	Tata McGraw Hill
2	K. A. Gangadhar	Electric Power Systems (Analysis , Stability and Protection)	Khanna Publishers
3	William Stevenson	Elements of Power System Analysis	McGraw Hill Series
4	Olle L. Elgerd	Electrical Energy System Theory	Tata McGraw Hill
5	B. R. Gupta	Power System Analysis and Design	S. Chand and Co.
6	C. L. Wadhava	Electrical Power System	New age international publishers
7	Abhijit Chakrabarty	Power System Analysis, operation and control	PHI

Websites:

- www.mahagenco.in
- www.mahatransco.in
- www.mahadisco.in
- www.mahasldc.org.in
- www.tatapower.com

Course Name : Diploma in Electrical Power System

Course Code : EP

Semester : Sixth

Subject Title : Power Quality

Subject Code : 17644

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

Rationale:

Modern power system has become a large size, complex, advanced integrated network. It is facing many field and on line challenges. The huge increase in sensitive loads, electronic controls, shunt capacitors for power factor correction, adjustable speed drives have raised the visibility of power quality problems. The common thread running through all these problems for increased concern about quality of electric power is continued push for increasing productivity for all utility customers. The equipment installed suffers the most common power disturbances and is sometimes a source of additional power quality problems.

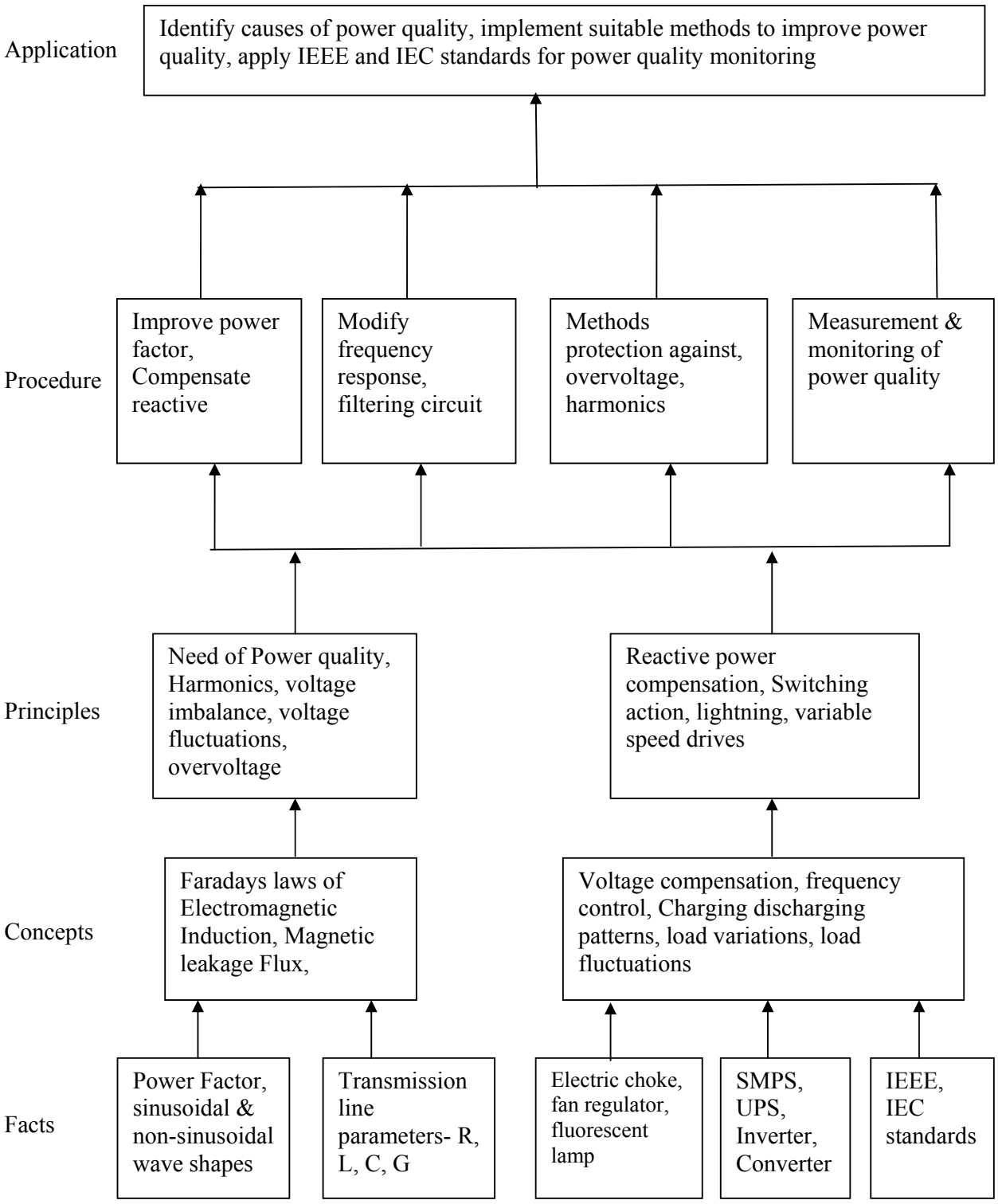
The subject deals with power quality issues between the utility and the end user. The content like the impact of transients, sags, swells, voltage imbalance, fluctuations, over voltages, capacitor switching, and harmonics are included in the curriculum. The contents on monitoring and mitigation techniques such as filters, compensators, power quality analyzers, flicker, meters, digital cameras useful to control quality power supply are also included.

General Objectives:

Students will be able to:

1. Understand the concepts of power quality problems.
2. Know the impacts of power quality problems on utility and end user.
3. Know the mitigation techniques for the various power quality problems.
4. Know the various IEEE and IEC standards related to power quality issues.
5. Understand the power quality monitoring and assessment tools.

Learning Structure:



Theory:

Topics and Contents	Hours	Marks
Topic 1: Power Quality Problems Specific Objectives: ➢ Understand concept of power quality ➢ Know the importance of power quality ➢ Analyze the power quality problems Contents: 1.1 Concept and importance of Power quality **04 Marks** 1.2 Concept of transients • Impulsive transients- definition, characteristics • Oscillatory transients- definition, characteristics 1.3 Long duration voltage variations **08 Marks** • Over voltages- definition, impacts • Under voltages- definition, impacts • Sustained Interruptions- definition, impacts 1.4 Short Duration voltage variations • Interruption- definition, impacts • Sags and Swells- definition, impacts 1.5 Waveform Distortion **06 Marks** • DC offset- concepts, causes, impacts • Harmonics and Inter harmonics - concepts, causes, impacts • Notching- concepts, causes, impacts 1.6 Voltage imbalance, voltage fluctuations, power frequency variations- concept, impacts	10	18
Topic 2: Sags and Interruptions **Specific Objectives** ➢ Identify causes of sags and interruptions ➢ Select method of improving voltage sag 2.1 Sources of voltage sag and interruptions **08 Marks** 2.2 Equipment sensitivity to voltage sag- concept, classification 2.3 Methods of improving voltage sag performance **12 Marks** • Ferro-resonant transformer- working principle, operation • Magnetic Synthesizers- operation • Active series compensators- operation, special features • Online UPS, Standby UPS, Hybrid UPS- block diagram, operation • Motor Generator switches- diagram, operation	12	20
Topic 3: Transient Overvoltage **Specific Objectives** ➢ Identify causes of transients ➢ Know the methods of overvoltage protection 3.1 Sources of transients • Capacitor switching, magnification of capacitor switching transients • Lighting and Ferro-resonance- characteristics, impacts 3.2 Methods of overvoltage protection • Surge arrestors, utility surge arrestors, surge suppressors, isolation transformers- operation • Low pass filters, low impedance power conditioners-diagram, operation	12	16

Topic 4: Harmonics **Specific Objectives:** ➢ Understand concept of harmonics ➢ Identify causes and impacts of harmonics ➢ Select methods of controlling harmonics 4.1 Concept of total harmonic distortion, harmonic phase sequences, inter harmonics **04 Marks** **4.2 to 4.4 ---------- 10 Marks** 4.2 Commercial sources of harmonics • 1- phase power supplies- characteristics, impacts • Fluorescent lighting- characteristics, impacts • Adjustable speed drives for HVAC and elevators- characteristics, impacts 4.3 Industrial sources of harmonics • 3-phase converters- characteristics, impacts • Arcing and saturable devices- characteristics, impacts • DC and AC drives- characteristics, impacts 4.4 Effects of harmonic distortion on capacitors, transformers, motors, energy and demand metering **4.5 and 4.6 ---------- 12 Marks** 4.5 Methods of controlling harmonics • Reducing harmonic currents in loads-Concept, features • Filtering- Concept, features • Modifying the system frequency response- Concept, features 4.6 Methods of Controlling harmonic distortion • Inline reactors-Concept, operation • Zigzag transformers-Concept, operation • Active and Passive filters (series and shunt)- Concept, operation	16	26
Topic 5: Power Quality Monitoring **Specific Objectives** ➢ Understand the necessity of PQ monitoring ➢ Select instruments for PQ measurement ➢ Know the PQ monitoring standards 5.1 to 5.3 ---------- **10 Marks** 5.1 Objectives of PQ monitoring 5.2 Procedure of PQ monitoring 5.3 PQ measuring instruments • Multimeters, Oscilloscopes- operation, characteristics • Digital cameras- operation, characteristics, special features • Spectrum and Harmonic Analysers- operation, characteristics, special features • Smart PQ monitors- operation, special features 5.4 PQ monitoring standards **10 Marks** • IEC 61000-4-30- details of testing PQ measurement methods • IEEE 1159- details, guidelines of PQ monitoring • IEEE 519-1992 Details, guidelines of harmonics • IEC 61000-2-2, IEC 61000-3-2, IEC 61000-3-4	14	20
Total	**64**	**100**

Practical:
Skills to be developed:

Intellectual Skills:

1. Understand the problems of power quality.
2. Identify causes and sources.
3. Suggest the method of improvement.

Motor Skills:

1. Collect information from various resources.
2. Measure parameters and record.
3. Observe and interpret the waveforms.

List of Practicals:

1. Identify the causes of voltage fluctuations and frequency fluctuations on different electrical gazettes
2. Select one method of improving sags. Write procedure and precautions while applying it.
3. Collect the information of transient over voltages and latest methods of overvoltage protection from internet and write a report on it.
4. Collect the details of harmonic distortion controlling devices from various manufacturers and write a report on it.
5. Search case studies on impact of harmonics caused by electrical furnaces, transformers, motors and nonlinear loads and write report on it. Also write the latest methods of controlling these impacts
6. Prepare a PQ monitoring survey report of a area and identify the locations of PQ monitoring.
7. Collect information on harmonic analysers and write a report on basis of specifications and special features.
8. Collect the details of IEEE 1159 standards for PQ monitoring and write a report mentioning procedure and special features.
9. Collect the details of IEC 61000-4-30 regarding testing and measurement of power quality problems
10. Search for details of latest methods of power quality measuring equipments from different manufactures and write a report on it.
11. Collect standards for harmonics and write a report on procedure and special features.

Learning Resources:
Books:

Sr. No.	Author	Title
01	Heydt	Power quality
02	IEEE Standard 512	Recommended practices for power quality
03	Dugan	Power quality

Websites:

1. http://powerstandards.com/tutor.htm
2. http://www.powerqualityinternational.com/pqi-case-studies.asp
3. http://www.powerqualityinternational.com/pqi-papers-articles.asp
4. http://www.powerqualityinc.com
5. http://www.ornl.gov/sci/ees/etsd/pes/pubs/ORNLTM200491FINAL.pdf
6. http://powerstandards.com/IEC.htm
7. http://powerstandards.com/IEEE.htm

Course Name : Diploma in Electrical Power System

Course Code : EP

Semester : Sixth

Subject Title : Renewable Energy Sources (Elective)

Subject Code : 17645

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
04	--	02	03	100	--	--	25@	125

NOTE:

- **Two tests each of 25 marks to be conducted as per the schedule given by MSBTE.**
- **Total of tests marks for all theory subjects are to be converted out of 50 and to be entered in mark sheet under the head Sessional Work (SW).**

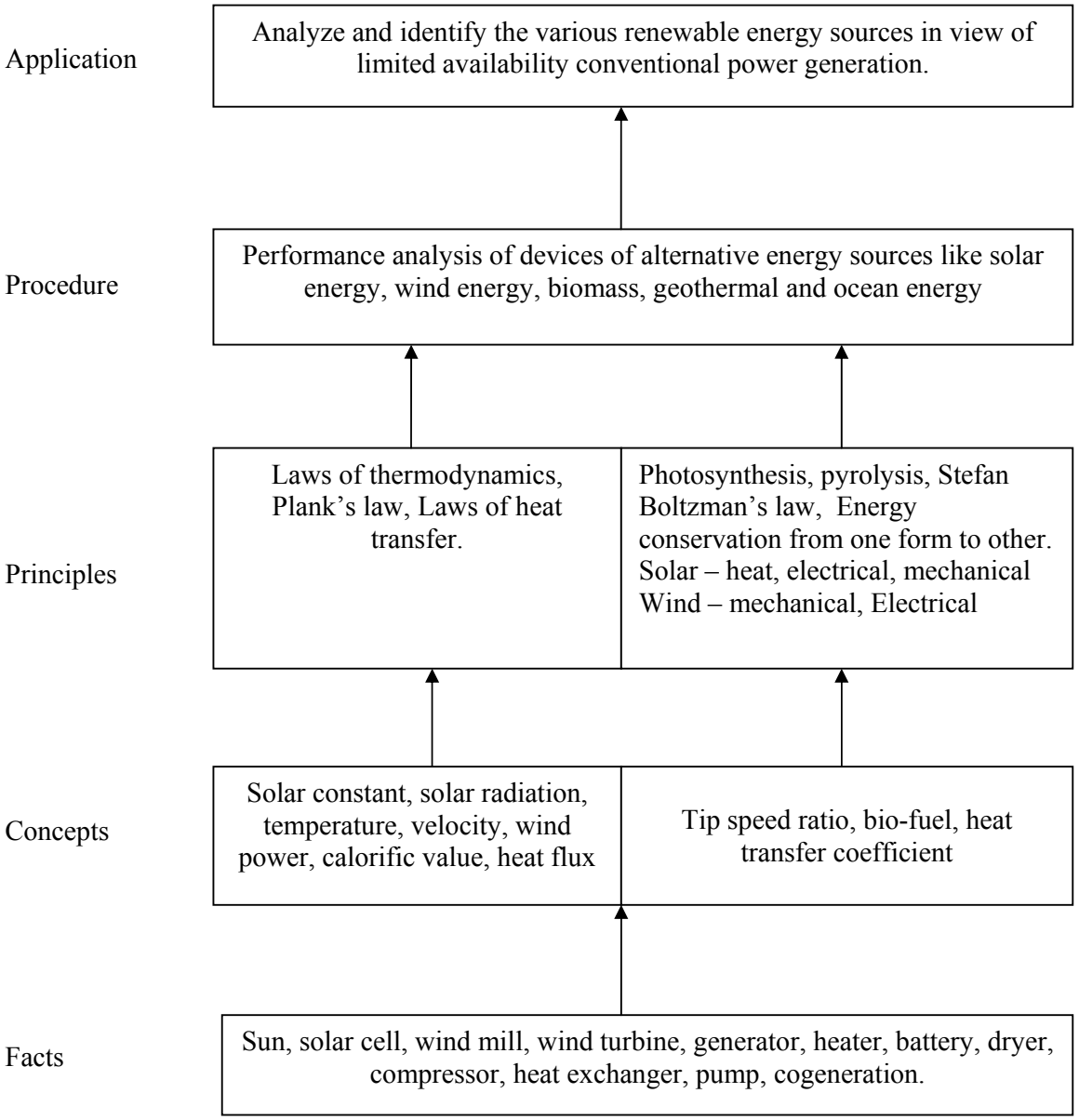
Rationale:

Energy is an important aspect in all sectors of country's economy. The energy crisis is mainly caused due to increased population, enhanced standard of living, life style, rapid urbanization. The conventional energy sources are insufficient to meet these demands and causing deleterious effects on human health and natural environment. Hence, alternative energy sources which are eco-friendly are used for fulfilling the energy demands. This subject helps the engineers to develop, operate and maintain these systems.

General Objectives:

1. Develop awareness for effective utilization of renewable energy sources.
2. Understand sustainability problem of present energy system and its potential solution.
3. Identify different components of all renewable energy devices.

Learning Structure:



Theory:

Topic and Contents	Hours	Marks
Topic 1: Introduction to Energy Sources **Specific Objectives:** ➢ Prospects of alternate energy sources. ➢ Need for alternate energy sources. **Contents:** 1.1 Types of Energy sources (Primary, Secondary, Supplementary). 1.2 Energy scenario in India (Energy consumption, Energy production, various sources and Their limitations). 1.3 Necessity of alternate energy sources. 1.4 Renewable Energy Sources Definition and examples 1.5 Environmental aspects of energy and sustainable development	06	10
Topics 2: Basics of Solar Energy **Specific Objectives:** ➢ Identify instruments used for measurement of solar radiation. ➢ Understand methods of solar radiation measurement **Contents:** 2.1 Solar Radiation • Solar radiation at the earth's surface: Spectral Distribution of Extra Terrestrial Solar Radiation • Schematic representation of Distribution of Solar energy as direct, diffused, total radiation. • Solar constant: definition and formula (No numerical) 2.2 Radiation Geometry • Definition and concept of latitude of location, • Declination, hour angle, • Solar azimuth angle, zenith angle, incident angle 2.3 Solar Radiation Measurements: Construction, working and limitations of : • Pyrheliometer for measurement of beam radiation. • Pyranometer for measurement of total radiation or global radiation. 2.4 Solar radiation on tilted surface: • Definition of tilt factor for beam radiation, • Diffused radiation • Deflected radiation stating impirical formula. (Simple numerical)	10	16
Topic 3: Solar Thermal and PV Systems ➢ Select different types of solar energy collectors, storage devices ➢ Decide the rating of PV cell. ➢ List limitations of Solar Power Generation. **Contents:** **3.1 Solar Collectors** • Classification of Solar collectors • Construction, working and applications of : Flat plate collectors, Concentrating type collectors, parabolic	16	24

Topic and Contents	Hours	Marks
collectors, modified flat plate collectors 3.2 Solar heating systems • Principle of heat conversion • Types of Solar Heating systems: components, specifications, installation and maintenance 3.3 Solar Cooking System • Principle of solar cooking • Components, material, specification and operation of: Box type solar cooker, Dish type solar cooker, Advanced solar cooker • Advantages and limitations 3.4 Solar Furnaces: Construction , operation and specification 3.5 Solar dryer, solar greenhouse: Construction , operation 3.6 Solar space heating and cooling: Principle, operation, applications 3.7 Solar PV System • Components of Solar cell • Construction of Solar PV module, panel • Maximum power point tracker (MPPT) • V-I characteristic of solar cell, efficiency of solar PV cell 3.8 Solar PV Applications • Solar PV lantern: Construction, operation • Solar Home lighting: Operation and applications • Solar water pumping system: operation, advantages • Functional block diagram of Photovoltaic Power Generating System, • Advantages and disadvantages. • Solar pond: principle, working, application		
Topic 4 : Wind Energy **Specific Objectives:** ➢ Select the site for wind mills. ➢ Identify different components of wind energy generating system and their functions. ➢ Select the type of generators used depending on wind power. **Contents:** 4.1 Meaning of the terms: Power in the wind, Maximum power, Power Coefficient, forces on blades and thrust on turbines. Wind Energy conversion. 4.2 Site selection consideration. 4.3 Block diagram showing basic components of Wind electric system and function of each block. 4.4 Types of Wind turbines 4.5 Construction, working, advantages and disadvantages of horizontal and vertical axis wind mills, 4.6 Wind Electric Generating Systems • Block diagram and working of constant speed constant frequency system. • Variable speed constant frequency system. • Variable speed variable frequency system. • Salient features and characteristics of synchronous generator and induction generators used in wind mills. 4.7 Area of applications of wind energy.	12	16

Topic and Contents	Hours	Marks
Topic 5 : Energy from Biomass **Specific Objectives:** ➢ Identify different bio-energy sources. ➢ Select type of biomass plant depending upon availability of waste. ➢ Identify different biogas plant. **Contents:** 5.1 Bio-energy sources. • Energy crops (woody crops, agriculture crops). • Wastes (wood residues, animal waste, municipal waste). 5.2 Methods of obtaining energy from biomass. • Combustion • Anarobic Digestion • Pyrolysis • Gasification • Fermentation (Definition and brief description of each method). 5.3 Thermal classification of biomass. 5.4 Classification of biomass Gasifiers (schematic diagram and working of) • Fixed bed gasifier • Fluidized bed gasifier 5.5 Classification of biomass plants. • Continuous and batch type • Dome and Drum type • Different variations in Drum type • Advantages and disadvantages of Drum and dome type plants. (Brief description of working with schematic diagram).	10	16
Topic 6 : Other Energy Sources **Specific Objectives:** ➢ Identify different geothermal energy and geothermal sources. ➢ Identify different methods of Ocean Thermal Electric Power Generation ➢ List advantages and disadvantages of Tidal Power Plant ➢ Understand the operation of fuel cell and hydrogen energy **Contents:** 6.1 Concept of geothermal energy and geothermal sources • Hydrothermal, geopressured, petrothermal, magma volcano: Diagram showing typical geothermal field • Operation of geothermal power plant with schematic diagram • Advantages and disadvantages of geothermal energy. • Application of Geothermal energy. 6.2 Ocean Thermal Electric Power Generation: • Construction and operation of the plant with diagram of Closed cycle / Anderson cycle, Open cycle / Claud cycle • Site selection for Ocean Thermal Electric Power Plant 6.3 Energy from Tides • Principles of Tidal Power Generation • Components and their functions: Dams(Barrage), Gates and Locks, Power House • Operation method of utilization of Tidal Energy: Single basin	10	18

Topic and Contents	Hours	Marks
arrangement , Double basin arrangement • Site requirement • Advantages and limitations 6.4 Emerging technologies • Fuel Cell: Principle, construction, operation, applications • Hydrogen Energy: Principle, applications, advantages, limitations		
Total	**64**	**100**

List of Assignments:

1. Measurement of solar radiation by solar measurement kit.
2. Determine the capacity of solar water heater depending upon quantity of water to be heated. State the procedure for erection
3. Collect information about PV cells: compare them on the basis of ratings, cost, application and life.
4. Search on different areas for economic applications of solar energy.
5. Collect information about different types of wind mills in Maharashtra state: Installed capacity, location, type and company.
6. Visit to any solar and Wind power plant and prepare a report mentioning, generating capacity, and specification, type of generator and wind mill used.
7. Collect the case studies of biomass generation and Municipal Solid waste projects in Maharashtra and write a report on it.
8. Collect information of potential of geothermal energy, tidal energy and wave energy in India form internet, journals and magazines
9. Collect information of design, operation and applications of fuel cells
10. Collect information from journals, magazines, and from internet related to "Recent trends in renewable energy sources". Present the seminar on the same.
11. Prepare a report on implementation of renewable energy for Rural electrification in India

Learning Resources:
Books:

Sr. No.	Author	Title	Publisher
1	G. D. Rai	Non-Conventional Energy Sources	Khanna Publications
2	S. P. Sukhatme	Solar Energy	Tata McGraw Hill
3	Abbasi	Renewable energy sources:Their impact on global warming and pollution.	PHI

4	Dr. H. S. Mukund	Understanding Clean Energy and Fuels from Biomass	Wiley India
5	Kothari,Singal & Rajan	Renewable Energy Sources and Emerging Technologies	PHI
6	Boyle	Renewable Energy Power for Sustainable Future: Second edition	Oxford University press

Websites:

1. www. nptel.iitm.ac.in
2. www. solardyne.com
3. www. otherpower.com
4. www. solarenergy.com
5. www. windpower.org
6. www. alternativesourcesofenergy.net
7. www. mnre.gov.in
8. www. howstuffworks.com
9. www.mahaurja.org/com

Course Name : Electrical Engineering Group

Course Code : EE / EP

Semester : Sixth

Subject Title : Project

Subject Code : 17801

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	04	--	--	--	50#	50@	100

Rationale:

Diploma holders need to be capable of doing self study throughout their life as the technology is developing with fast rate. Student will be able to find out various sources of technical information and develop self-study techniques to prepare a project and write a project report.

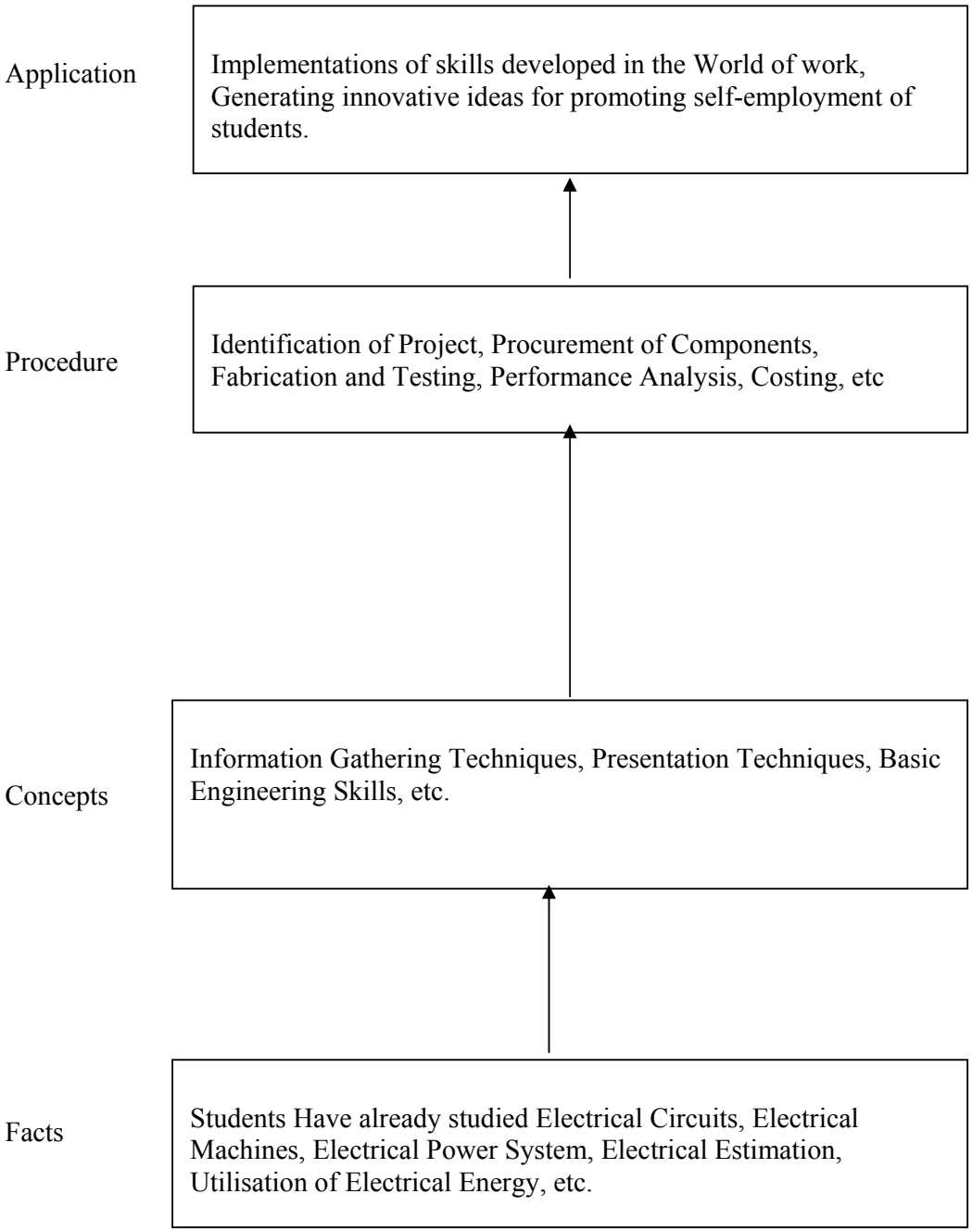
This subject is intended to teach students to understand facts, concepts and techniques of electrical equipments, its repairs, fault finding and testing, estimation of cost and procurement of material, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skills and attitudes to work in industry and can start his own enterprise.

Objectives:

The students will be able to,

1. Work in Groups, Plan the work, and Coordinate the work.
2. Develop leadership qualities
3. Analyse the different types of Case studies.
4. Develop basic technical Skills by hands on experience
5. Write project report.
6. Develop skills to use latest technology in Electrical field.

Learning Structure:



Contents:

Projects
1. Design of Illumination Scheme (Up to 20 KW) for Hospital / Shopping Mall/Cinema Theatre/Commercial Complex/Educational Institute/Industrial Complex. 2. Design of Rural Electrification Scheme for small Village, Colony. 3. Case Studies Related to Industries – Operation / Maintenance / Repair and Fault Finding. (Refer Guideline Document). 4. Energy Conservation and Audit. 5. Substation Model (Scaled) 6. Wind Turbine Model (Scaled) 7. Pole Mounted Substation Model (Scaled) 8. Rewinding of Three Phase/Single Phase Induction Motor. 9. Rewinding of Single Phase Transformer. 10. Fabrication of Inverter up to 1000 VA, Battery Charger. 11. Fabrication of Small Wind Energy System for Battery Charging. 12. Fabrication of Solar Panel System for Battery Charging. 13. Microprocessor/ Micro controller Based Projects. 14. PC Based Projects and Simulation Projects.
Seminar A group seminar to be conducted after completion of Project work and marks to be allotted separately under head Seminar in CIAAN format of Project

Note: Out of Four hours two hours should be allotted for giving the Instructions for preparing a Project Report. (Refer Guideline Document for Format of Project Report)

Learning Resources:

1. Books/Magazines:

Sr. No.	Name of the Magazine
1.	IEEE Transactions/Journals
2.	Electrical India
3.	IEEMA Journal
4.	Elecrama
5.	Technorama
6.	Urja
7.	Industrial Automation
8.	Electronics for You
9.	Electronics Projects
10.	Computer World
11.	Chip

12.	Any Journal Related to Electrical Engg. / Electronics / Computer / Information Technology

Components of Project Report:

1. Synopsis- Project Summary (One page summary of entire project)
2. Action Plan of Project for both Semesters
3. Introduction (Promoters, Market Scope/ requirement)
4. Project Concept & Product (Details of product)
5. Manufacturing Process & Technology
6. Material and Machinery Required
7. Raw materials, Consumables & Utilities
8. Estimation (Assumptions, requirements)
9. Market (Survey, Demand & Supply)
10. Cost of Project,
11. Future Scope/ Benefit to Society
12. Conclusion.
13. References