

MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION , MUMBAI																		
TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES																		
COURSE NAME : ELECTRICAL ENGINEERING																		
COURSE CODE : EE																		
DURATION OF COURSE : SIX SEMESTERS									WITH EFFECT FROM 2008-09									
SEMESTER : SIXTH									DURATION : 16 WEEKS									
FULL TIME / PART TIME: FULL TIME									SCHEME : C									
SR. NO	SUBJECT TITLE	SUBJECT CODE	TEACHING SCHEME			EXAMINATION SCHEME												
			TH	TU	PR	PAPER HRS	TH		TEST	TOTAL		PR		OR		TW		
							Max	Min		Max	Min	Max	Min	Max	Min			
1	Management	9133	03	--	--	03	80	28	20	100	40	--	--	--	--	--	--	
2	Testing & Maintenance of Electrical Machines	9142	03	--	02	03	80	28	20	100	40	50#	20	--	--	25@	10	
3	Power Electronics and Drives	9143	03	--	02	03	80	28	20	100	40	--	--	25@	10	--	--	
4	Heating, Ventilation and Air conditioning	9146	03	--	02	03	80	28	20	100	40	--	--	25@	10	--	--	
5	<b>Elective III (Any One)</b>																	
	Electric Traction – II	9144	03	--	02	03	80	28	20	100	40	--	--	25#	10	25@	10	
	Repairs and Maintenance of Electrical Equipment	9145	03	--	02	03	80	28	20	100	40	--	--	25#	10	25@	10	
	Microprocessor and Microcontroller	9147	03	--	02	03	80	28	20	100	40	--	--	25#	10	25@	10	
	Power System Operation and Load Dispatch	9148	03	--	02	03	80	28	20	100	40	--	--	25#	10	25@	10	
7	Industrial Project	--	--	--	04	--	--	--	--	--	--	--	--	50#	20	50@	20	
8	Professional Practices- VI	--	--	--	05	--	--	--	--	--	--	--	--	--	--	50@	20	
<b>TOTAL</b>			<b>15</b>	<b>--</b>	<b>17</b>	<b>--</b>	<b>480</b>	<b>--</b>	<b>120</b>	<b>600</b>	<b>--</b>	<b>50</b>	<b>--</b>	<b>125</b>	<b>--</b>	<b>150</b>	<b>--</b>	

STUDENT CONTACT HOURS PER WEEK (FORMAL TEACHING) : 32 HRS.  
**THEORY AND PRACTICAL PERIODS ARE OF 60 MINUTES EACH.**  
@ - INTERNAL ASSESSMENT, # - EXTERNAL ASSESSMENT.  
**TOTAL MARKS : 925**  
ABBREVIATIONS: TH – THEORY, TU – TUTORIAL, PR – PRACTICALS, OR – ORAL, TW – TERMWORK.  
**Assessment of Practical, Oral & Term work to be done as per the prevailing norms of curriculum implementation & assessment.**

**Course Name: Electrical Engineering Group**

**Course Code : EE/EP**

**Semester : Sixth**

**Subject Title : Management**

**Subject Code : 9133**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
03	--	--	03	80	20	--	--	--	100

**Rationale:**

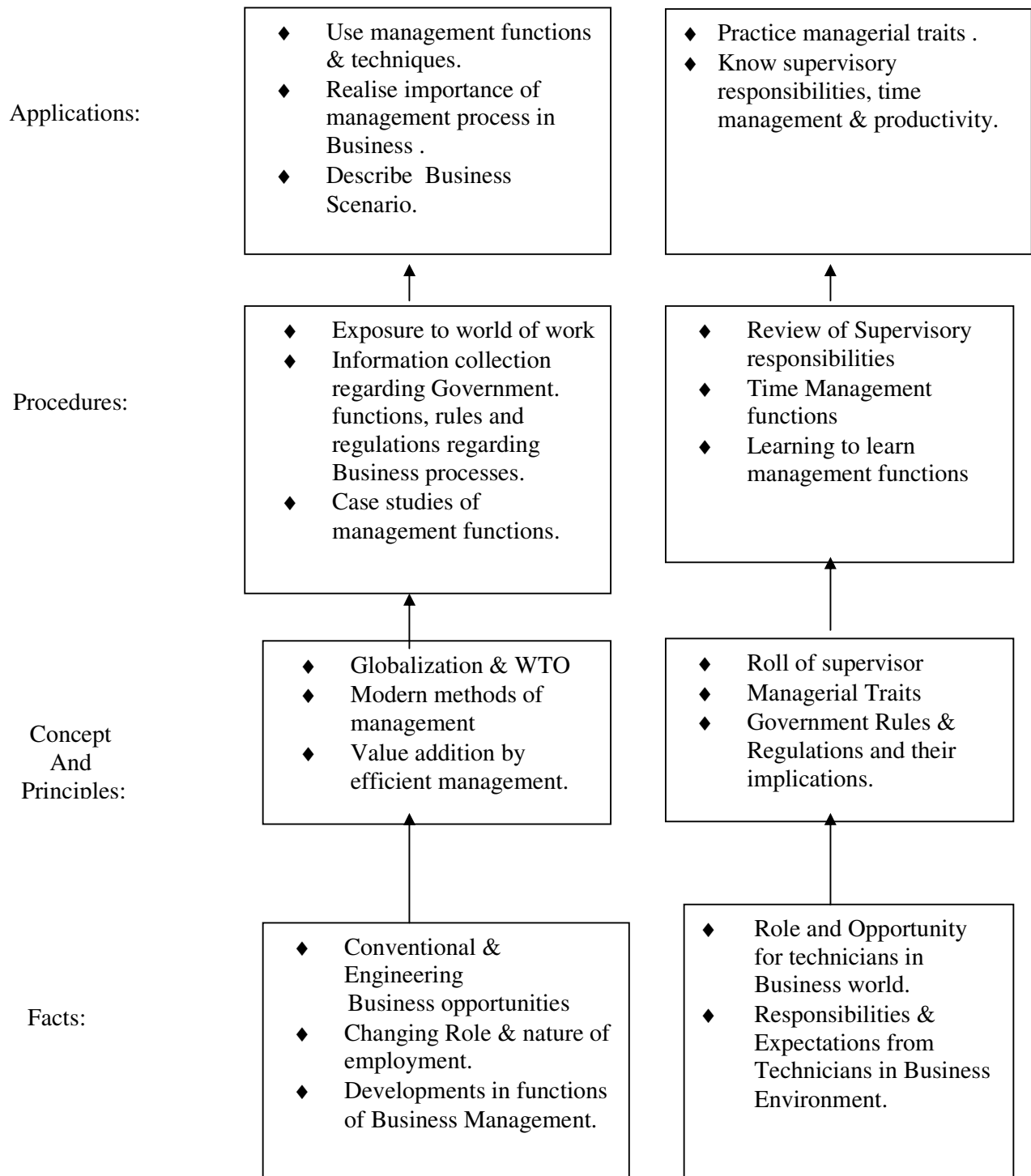
After completion of three years of technical training, Polytechnic students are expected to enter in to the World of Work. The business environment is altogether different and new to the students. A proper introduction and understanding of Business Processes is therefore essential for all Polytechnic students. Management is a subject which deals with basics of Managerial science required to understand the processes in Industrial & Commercial environment. This will enable the students of Polytechnics to become familiar and to understand various Business Organizational structures, their functioning and the Role these technicians will have to play in these setups with responsibilities.

**Objective:**

The students will able to:

1. Familiarize environment in the world of work
2. Explain the importance of management process in Business.
3. Identify various components of management.
4. Describe Role & Responsibilities of a Technician in an Organizational Structure.
5. Apply various rules and regulations concerned with Business & Social responsibilities of the Technician.

## Learning Structure:



## Contents: Theory

Chapter	Name of the Topics	Hours	Marks
01	<b>Overview Of Business</b> 1.1.Types of Business 1.2.Industrial sectors – Textile, Engineering, Agro etc service sector – Introduction & Characteristics 1.3 Globalization- Strength & weaknesses.	02	---
02	<b>Management Process: -</b> 2.1 What is Management? Evolution , various Definitions, concept of Management- Levels of Management, Administration and Management 2.2 Principles of Management 2.3 Functions of Management: Planning , Organizing, Directing , controlling , Motivating , Coordinating , Decision Making	07	12
03	<b>Organizational Management</b> 3.1 What is organization – Definition and steps in organization. 3.2 Organization Structure - Departmentation - Division of work base Centralized / Decentralized - Authority of Responsibility base, Span of Control Forms of Organization- Line , Line –staff etc. 3.3 Forms of ownerships – Partnership, Proprietorship, Joint stock, Co-operative society , Govt. Sector etc.	07	12
04	<b>Human Resource Management</b> 4.1 Personnel Management – What is Personnel Management and Functions of Personnel Management. 4.2 Staffing – Planning & Recruitment procedure 4.3 Personnel – Training & Development Types of training – Induction, skill enhancement, Workers & Supervisors training programs Motivation . 4.4 Safety Management – Causes of Accidents, Safety Procedures , Introduction to Industrial Acts- Factory act, ESI, workman compensation, Dispute act.	08	16
05	<b>Financial Management</b> 5.1. Financial Management- Objectives & Functions 5.2. Capital Generation & Management – Types of capitals, Sources of finance 5.3. Budgets and accounts –	08	16

	Types of Budgets & accounts, preparation of Profit & Loss Account, Balance sheet etc. 5.4. Taxes & Tax Registration – Introduction and types of Taxes – Excise Service Tax, Income Tax, VAT Sales tax.		
<b>06</b>	<b>Materials Management</b> 6.1. Inventory Management – Meaning & Objectives 6.2 ABC Analysis Purchase Procedure- Purchase types , searching & Selection of sources. Global purchasing, Global outsourcing. 6.3 Economic Order Quantity: Models & Analytical Treatment 6.5 Modern Techniques of Material Management – JIT, SAP/ERP	<b>08</b>	<b>16</b>
<b>07</b>	<b>Project Management</b> 7.1 Project Management - Introduction & Meaning 7.2 Project Planning & Control – CPM/PERT Techniques Concept of Break Even Analysis 7.3 Productivity – Meaning, Means & Measures of increasing productivity, Concept of Quality Circle , 5 'S', Kaizen (waste control), 6 sigma. 7.4 I. P.R.	<b>08</b>	<b>08</b>
<b>Total</b>		<b>48</b>	<b>80</b>

**Learning Resources:**

**Books:**

<b>Sr. No</b>	<b>Author</b>	<b>Name Of Book</b>	<b>Publisher</b>
01	Dr. O.P. Khanna	Industrial Engg & Management	Dhanpal Rai & sons New Delhi
02	Dr. S.C. Saksena	Business Administration & Management	Sahitya Bhavan Agra
03	W.H. Newman E.Kirby Warren Andrew R. McGill	The process of Management	Prentice- Hall of India Pvt. Ltd. New Delhi - 110001

**2. Video Cassettes:**

<b>No</b>	<b>Subject</b>	<b>Source</b>
1.	Business opportunity selection and guidance	Website : <a href="http://www.ediindia.org">http://www.ediindia.org</a>
2.	Planning for completion and Growth	

**COURSE NAME : ELECTRICAL ENGINEERING GROUP.**

**COURSE CODE : EE/EP**

**SEMESTER : SIXTH**

**SUBJECT TITLE : TESTING & MAINTENANCE OF ELECTRICAL MACHINES**

**SUBJECT CODE : 9142**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
03	--	02	03	80	20	50#	--	25@	175

**Rationale:**

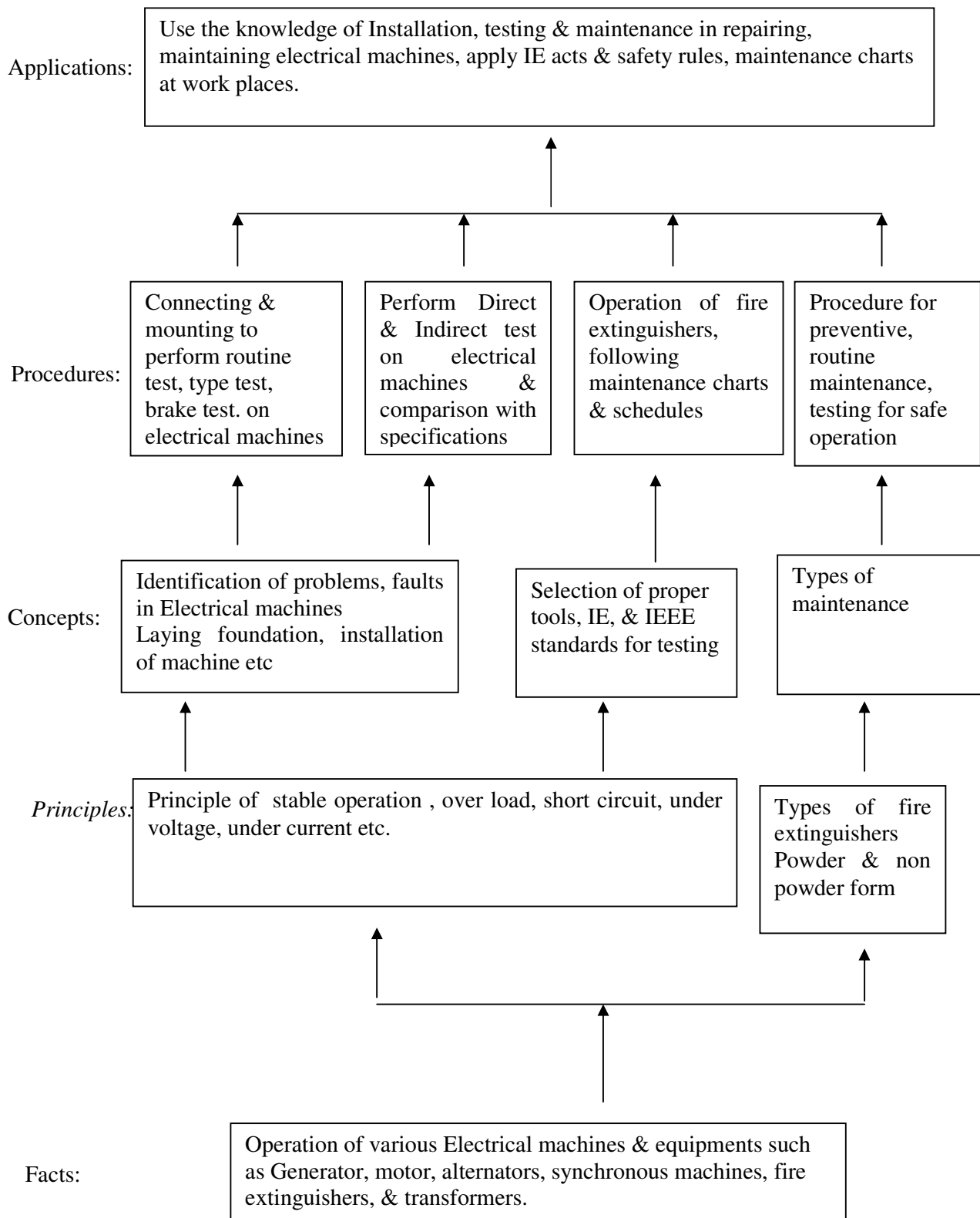
This is technology level subject with application in Industry, commercial, public utility departments such as PWD, Irrigation, MSEB, water supply & sewage board etc. After studying this subject student will be able to inspect, test, install & commission electrical machines as per IS and International standards. He/She shall carry out routine & preventive maintenance of electrical machines & possesses knowledge of Indian Electricity Act, safety rules, safety of machines & persons, prevention of accident. This will help him to initiate total productive maintenance.

**Objective:**

Student will be able to

1. Know safety measures & state safety precautions.
2. Test single phase, three phase transformer, DC & AC machine as per IS.
3. Identify / Locate common troubles in electrical machines & switch gear.
4. Plan & carry out routine & preventive maintenance.
5. Install LV switchgear & maintain it.
6. Ascertain the condition of insulation & revarnishing if necessary.
7. Initiate total productive maintenance.

**Learning structure:**



**Contents: Theory**

Chapter	Name of the Topic	Hours	Marks
01	<p><b>Safety &amp; Prevention of Accidents:</b>            Definition of terminology used in safety; safety, hazard, accident, major accident hazard, responsibility, authority, accountability, monitoring,            I.E. Act &amp; statutory regulations for safety of persons &amp; equipments working with electrical installation,            Dos &amp; don'ts for substation operators as listed in IS            Meaning &amp; causes of electrical accidents factors on which severity of shock depends,            Procedure for rescuing the person who has received an electric shock, methods of providing artificial respiration,            Precautions to be taken to avoid fire due to electrical reasons, operation of fire extinguishers.</p>	04	08
02	<p><b>General Introduction:</b>            Objectives of testing significance of I.S.S. concept of tolerance, routine tests, type tests, special tests.            Methods of testing a) Direct, b) Indirect, c) Regenerative.            Concept of routine, preventive &amp; breakdown maintenance, advantages of preventive maintenance, procedure for developing preventive maintenance schedule,            Factors affecting preventive maintenance schedule.            Introduction to total productive maintenance.</p>	07	12
03	<p><b>Testing &amp; maintenance of rotating machines:</b>            Type tests, routine tests &amp; special tests of 1 &amp; 3 phase Induction motors,            Routine, Preventive, &amp; breakdown maintenance of 1 &amp; 3 phase Induction motors as per IS 9001:1992            Parallel operation of alternators, Maintenance schedule of alternators &amp; synchronous machines as per IS 4884-1968            Brake test on DC Series motor.</p>	05	08
04	<p><b>Testing &amp; maintenance of Transformers:</b>            Listing type test, routine test &amp; special test as per I.S. 2026-1981            Procedure for conducting following tests:            Measurement of winding resistance, no load losses, &amp; no load current, Impedance voltage, load losses, Insulation resistance, Induced over voltage withstand test, separate source voltage withstand test, Impulse voltage withstand test, Temperature rise test of oil &amp; winding, Different methods of determining temp rise-back to back test, short circuit test, open delta (delta – delta) test.            Preventive maintenance &amp; routine maintenance of distribution transformer as per I.S. 10028(part III): 1981, Periodic checks for replacement of oil, silica gel, parallel operation of 1 &amp; 3 phase transformer, load sharing calculations (numerical)</p>	12	18
05	<p><b>Testing &amp; maintenance of Insulation:</b>            Classification of insulating materials as per I.S. 8504(part III)1994, factors affecting life of insulating materials, measurement of insulation resistance &amp; interpretation of condition of insulating. Methods of measuring temperature of internal parts of windings/machines &amp; applying the correction factor when the</p>	08	14

	<p>machine is hot. Properties of good transformer oil, list the agents which contaminates the insulating oil, understand the procedure of following tests on oil as per I.S. 1692-1978</p> <p>a) acidity test b) sludge test c) crackle test e) flash point test.</p> <p>Filtration of insulating oil protection of electrical equipments (insulation) during the period of inactivity.</p> <p>Methods of cleaning the insulation covered with loose, dry dust, sticky dirt, &amp; oily viscous films, procedure for cleaning washing &amp; drying of insulation &amp; revarnishing</p> <p>Methods of internal heating &amp; vacuum impregnation.</p>		
<b>06</b>	<p><b>Trouble shooting of Electrical Machines &amp; Switch gear:</b></p> <p>Significance of trouble shooting of various electrical machines and describes the procedure for the same.</p> <p>Internal and external causes of failure of equipment.</p> <p>Various types of faults (mechanical, electrical &amp; magnetic) in electrical machines reason for their occurrence, use of following tools: Bearing puller, Filler gauge, dial indicator, spirit level megger, earth tester, growler, multimeter, Trouble shooting charts for 1 &amp; 3-phase induction motor, 1 &amp; 3- phase transformer.</p> <p>List the common troubles in electrical installation &amp; cables</p> <p>Maintenance &amp; trouble shooting of LV switchgear like MCCB, ELCB, contactors &amp; batteries.</p>	<b>08</b>	<b>12</b>
<b>07</b>	<p><b>Installation:</b></p> <p>Factors involved in designing the machine foundation, Requirement of different dimension of foundation for static &amp; rotating machines procedure for levelling &amp; alignment of two shafts of directly &amp; indirectly coupled drives, effects of misalignment. Installation of rotating machines as per I.S. 900-1992.</p> <p>Use of various devices &amp; tools in loading &amp; unloading, lifting, carrying heavy equipment.</p>	<b>04</b>	<b>08</b>
<b>Total</b>		<b>48</b>	<b>80</b>

**Practical:**

Skills to be developed:

Intellectual skills:

1. Select appropriate meters & equipment
2. Recollect Testing & Maintenance procedures.

Motor Skills:

1. Accuracy of Measurement
2. Proper connections
3. Draw characteristics

**List of Practical:**

- 1) Draw circuit diagram select appropriate meters, connect it to perform routine test on single phase Induction motor

- 2) As per the given circuit diagram perform routine test on three phase Induction motor, & calculate the different parameters
- 3) Select two single phase transformers, perform polarity test, mark its terminals, select appropriate meters & perform back to back test, compare its regulation with direct loading method
- 4) Perform parallel operation of transformer as per I.S.
- 5) Perform parallel operation of alternator as per I.S.
- 6) Carry out OC & SC test on Induction motor, plot circle diagram, & calculate parameters
- 7) Perform brake test on DC series motor & plot characteristic of output against torque, speed, load current as per I. S. list suitable applications.

**B) Field work:**

- 8) Observe & carry out weekly, monthly & yearly maintenance of motor in your workshop & prepare its report

**C) Mini project:**

- 9) Prepare trouble-shooting chart for single and three phase transformers
- 10) Prepare trouble-shooting chart for single and three phase motors

**Learning Resources:**

**Books:**

Sr. No.	Author	Title	Publisher
01	B. L. Theraja	Electrical Technology Vol I To IV	S. Chand & Co., New Delhi
02	B. V. S. Rao	Operation & Maintenance Of Electrical Machines Vol - I	Media Promoters & Publisher Ltd. Mumbai
03	B. V. S. Rao	Operation & Maintenance Of Electrical Machines Vol - II	Media Promoters & Publisher Ltd. Mumbai
04	C.J. Hubert	Preventive Maintenance Hand Books & Journals	-----

**Course Name : Electrical Engineering Group**  
**Course Code : EE/EP**  
**Semester : Sixth**  
**Subject Title : Power Electronics and Drives**  
**Subject Code : 9143**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
02	--	02	03	80	20	--	25@	--	125

**Rationale:**

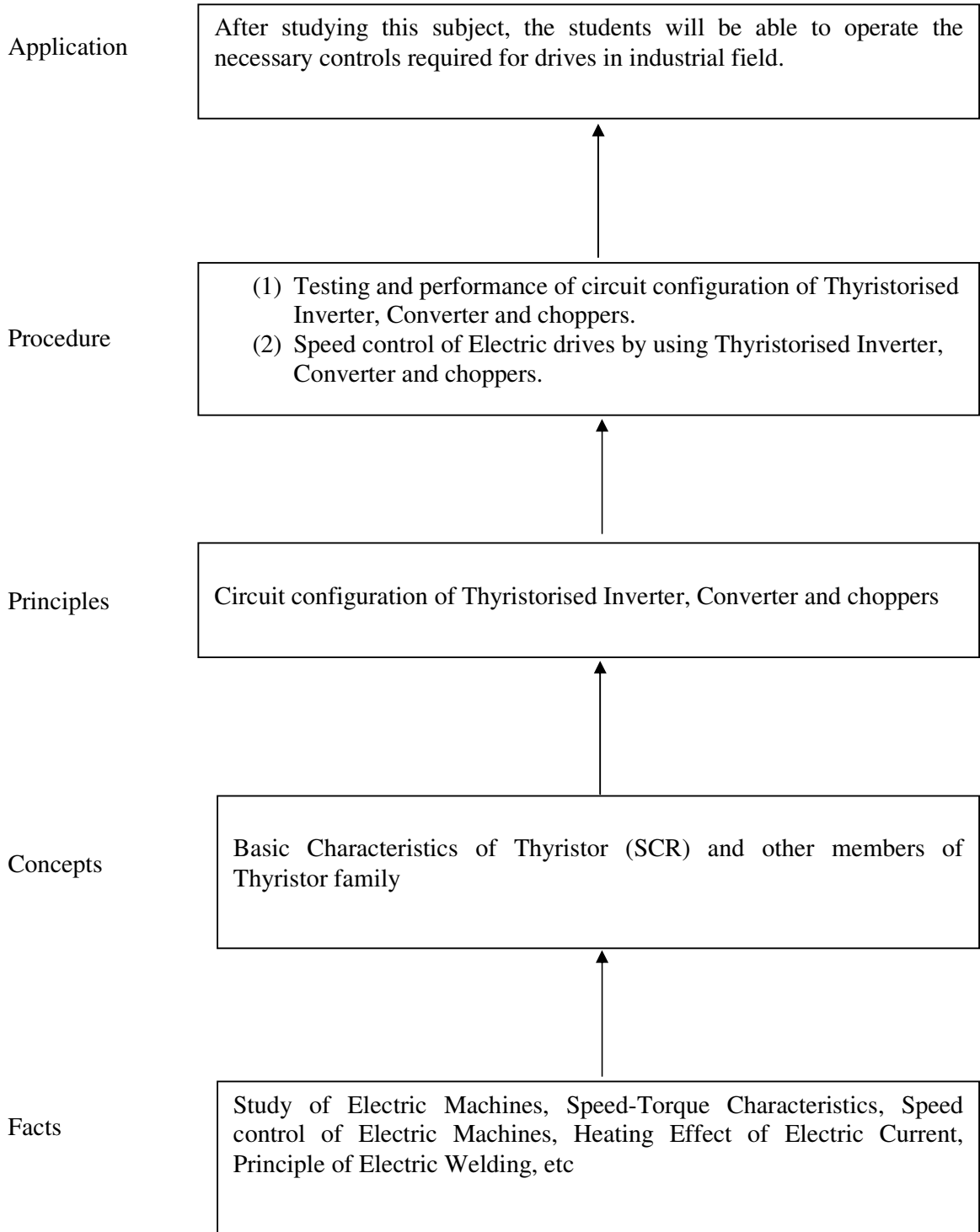
The field of electrical engineering is generally segmented into three major areas – Electronics, Power and Control. Power Electronics involves a combination of these three areas. In broad terms, the function of power electronics is to process and control the electrical energy by supplying voltage and current in a form that is optimally suited to the load. Now a day's electrical machine are controlled by Power Electronics methods. Also the various conventional control & relays are replaced by electronic control & relays, employing solid state power semiconductor devices. Hence, for electrical engineering Students it is desirable to study the course dealing with Power Electronics. This subject belongs to technology area.

**Objectives:**

The students will be able to:

1. Explain the construction and operation of power semiconductor devices and plot their characteristics.
2. Draw the circuit diagrams and explain the working of controlled rectifiers with appropriate waveforms.
3. Draw the circuit diagrams and explain the working of different types of Inverters with appropriate waveforms.
4. Explain the Voltage and Frequency Control Methods used in Inverters.
5. Draw the circuit diagrams and explain the working of different types of choppers with appropriate waveforms.
6. Apply the power electronic methods of controls in Electrical Engg. field.

**Learning Structure:**



**Contents: Theory****Note:** No Derivations and No Numerical for all Topics.

Chapter	Name of the Topics	Hours	Marks
01	<b>Power Semiconductor Devices:</b> 1.1 Thyristor (SCR) 1.2 Construction, Operation and Symbol 1.3 V-I Characteristics 1.4 Thyristor Turn Methods: Voltage Triggering, Gate Triggering, dv/dt Triggering and Light Triggering. 1.5 Gate Control: DC Gate Signal, AC Gate Signal and Pulse. 1.6 Thyristor Turn off Process 1.7 Thyristor Specifications and Ratings Voltage Ratings, Current Ratings, Power Ratings and Temperature Ratings. 1.8 Heat Sinks and Mountings 1.9 Thyristor Family: Symbols & V-I Characteristics	06	12
02	<b>Converters:</b> 2.1 – Introduction 2.2 – Single Phase Fully Controlled Half Wave Converter - With Resistive Load - With RL Load and Freewheeling Diode. 2.3 - Single Phase Fully Controlled Full Wave Converter - With Resistive Load - With RL Load. 2.4 - Single Phase Fully Controlled Bridge Converter - With Resistive Load - With RL Load 2.5 – Three Phase Fully Controlled Bridge Converter - With RL Load. 2.6 – Comparison of 3 $\phi$ and 1 $\phi$ Phase Converters. 2.7- Effect of Source Impedance on Converter Operation. 2.8 – Cycloconverters and Cycloinverters.: Single phase and three phase, principle of operation, Input output waveforms.	08	16
03	<b>Inverters:</b> 3.1 - Introduction 3.2 – Classification: 1 $\phi$ & 3 $\phi$ Inverters, Line Commutated & Forced Commutated Inverters, Series, Parallel, & Bridge Inverters. 3.3 – Series Inverter - Operation of Basic Series Inverter Circuit - Modified Series Inverter - Three Phase Series Inverter 3.4 – Parallel Inverter - Operation of Basic Parallel Inverter Circuit 3.5 – Single Phase Bridge Inverter - Half Bridge Inverter - Full Bridge Inverter 3.6 – Voltage and Frequency Control of 1 $\phi$ Inverters:	08	16

	<ul style="list-style-type: none"> <li>- Necessity of Control of Output Voltage</li> <li>- Methods for Output Voltage Control: External Control of DC Voltage, External Control of AC Voltage and Internal Control.</li> <li>- Pulse Width Modulation(PWM) Method: <ul style="list-style-type: none"> <li>- Single Pulse Width Modulation</li> <li>- Multiple Pulse Width Modulation</li> <li>- Sinusoidal Pulse Width Modulation</li> </ul> </li> <li>3.7 – Waveform Control (Harmonic Reduction) <ul style="list-style-type: none"> <li>- By Single Pulse Width Modulation</li> <li>- By Transformer Connections</li> <li>- By Using Filter(LC, Resonant, and OTT Filter)</li> </ul> </li> </ul>		
<b>04</b>	<p><b>Choppers:</b></p> <ul style="list-style-type: none"> <li>4.1 – Introduction</li> <li>4.2 – Chopper Principle</li> <li>4.3 – Control Techniques: <ul style="list-style-type: none"> <li>- Constant Frequency System</li> <li>- Variable Frequency System</li> </ul> </li> <li>4.4 – Classification of Choppers: <ul style="list-style-type: none"> <li>Class A, Class B, Class C, Class D and Class E</li> </ul> </li> <li>4.5 - Commutations Methods for Choppers: <ul style="list-style-type: none"> <li>Auxiliary Commutation, Load Commutation</li> </ul> </li> <li>4.6 – Jones Chopper</li> <li>4.7 – Step Up Chopper</li> </ul>	<b>08</b>	<b>12</b>
<b>05</b>	<p><b>Power Electronic Applications:</b></p> <ul style="list-style-type: none"> <li>5.1 – DC Drives: <ul style="list-style-type: none"> <li>5.1.1 – Speed control of DC series motor with single phase and three phase half and full controlled converter, step up and step down chopper.</li> <li>5.1.2 – Introduction to DC servo motor, Speed control of DC servomotor.</li> </ul> </li> <li>5.2 – AC Drives: <ul style="list-style-type: none"> <li>5.2.1 – Speed control of three phase Induction Motor with Variable frequency PWM VSI, Variable frequency square wave VSI, Variable frequency CSI, Variable frequency Variable Voltage, Cycloconverters.</li> <li>5.2.2 – Open/Closed loop control of stepper motor.</li> <li>5.2.3 – AC servomotor, speed control of AC servomotor.</li> </ul> </li> <li>5.3 – Other Applications: <ul style="list-style-type: none"> <li>- Static Circuit Breakers (DC &amp; AC).</li> <li>- Induction Heating Control.</li> <li>- Di-electric Heating Control.</li> <li>- Electric Welding Control. <ul style="list-style-type: none"> <li>- Battery Charging Control.</li> <li>- Static Excitation System for Alternators.</li> <li>- Static VAR Compensation System.</li> </ul> </li> </ul> </li> </ul>	<b>18</b>	<b>(24)</b>
<b>Total</b>		<b>48</b>	<b>80</b>

**Practical:**

Skills to be developed:

Intellectual skills:

1. Select appropriate devices and instruments
2. Testing & troubleshooting

Motor Skills:

1. Accuracy of Measurement
2. Proper connections
3. Draw characteristics

**List of Practicals:**

- (1) To identify the terminals and plot V-I Characteristics of Thyristor.
- (2) To study Full Wave Rectifier Using SCR and UJT.
- (3) To study Parallel Inverter Using SCR.
- (4) To study Bridge Rectifier Using SCR and UJT.
- (5) To study series Inverter Using SCR.
- (6) To study Chopper Using SCR.
- (7) To study Circuit Breaker Using SCR.
- (8) To study Battery Charger Using SCR.
- (9) TO Perform Speed control of DC series motor by static armature voltage control using single phase half/full controlled converter.
- (10) TO Perform speed control of three phase Induction motor using PWM/CSI Inverter. Interpret the speed – torque characteristics. Use the circuit as Variable Voltage Variable Frequency (V. V. V. F.) drive.

**Learning Resources:****Books:**

Sr. No.	Author	Title	Publisher
1.	B. R. Gupta ,V. Singhal	Power Electronics	S. K. Kataria & Sons
2.	Muhammad H. Rashid	Power Electronics	Prentice-Hall of India Pvt. Ltd.
3.	M. D. Singh, K. B. Khanchandani	Power Electronics	Tata McGraw-Hill
4.	G. K. Dubey	Fundamentals of Electric Drives	Narosa Publishing House
5.	V. Subrahmanyam	Electric Drives – Concepts and Applications	Tata McGraw-Hill

**COURSE NAME : ELECTRICAL ENGINEERING**  
**COURSE CODE : EE**  
**SEMESTER : SIXTH**  
**SUBJECT TITLE : HEATING, VENTILATION & AIR CONDITIONING**  
**SUBJECT CODE : 9146**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
02	--	02	03	80	20	--	25@	--	125

**Rationale:**

This is a technology subject which is an elective subject for third year diploma in Electrical Engineering. Presently the need of Heating Ventilation and Air conditioning (HVAC) is increasing with the growth in IT sector, commercial establishments, hospitals, hotels etc. Therefore there is a growing need of engineers / technicians in this field. Hence, technicians/supervisors from electrical engineering branch are also expected to have some basic knowledge of HVAC systems.

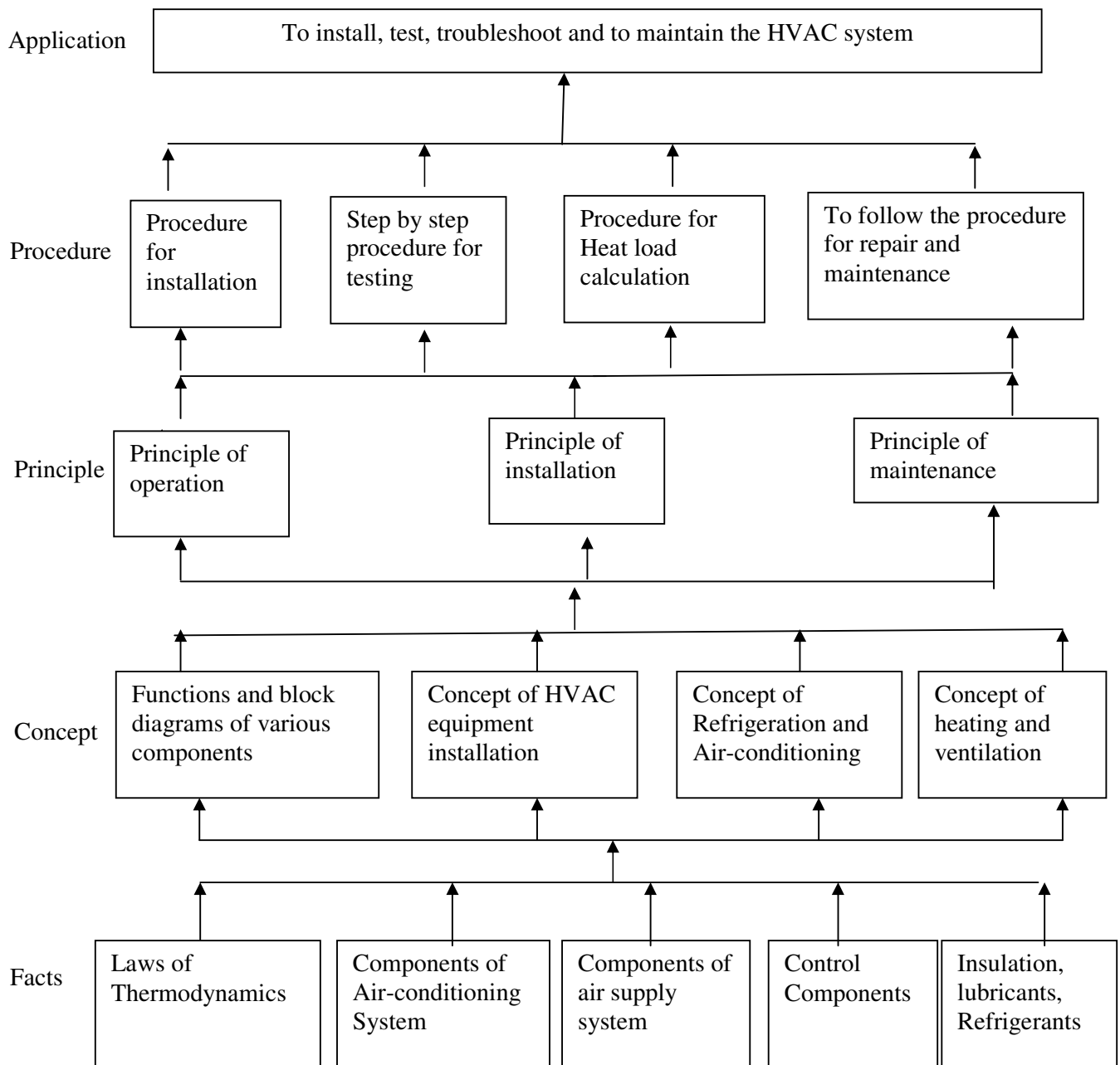
This subject covers installation, testing and maintenance of Heating Ventilation and Air conditioning systems. After completing this subject the student can carryout installation, testing and maintenance of HVAC equipment efficiently and effectively. He can work as service engineer or get self employed.

**Objectives:**

The student will be able to:-

1. Install HVAC equipment.
2. Test the equipment for its performance evaluation.
3. Carryout routine and preventive maintenance of HVAC system.
4. Troubleshoot and repair HVAC equipment.
5. Calculate heat load and approximate capacity of the equipment using thumb rule.
6. Select appropriate equipment.

## Learning Structure:



## Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	<b>Introduction</b> 1.1 Laws of thermodynamics 1.2 Comparison between heat engine, heat pump and refrigeration 1.3 Definitions of refrigeration, ton of refrigeration, COP, enthalpy, entropy	02	04
02	<b>Types of refrigeration systems</b> 2.1 Vapour compression system – components used in vapour compression system, operation of vapour compression system, its representation on P – H and T – S diagrams, effect of superheating and under cooling of refrigerant. 2.2 Vapour absorption system – components used in vapour absorption system, its operation, its merits and demerits compared to vapour compression system 2.3 Air refrigeration system – components used in air refrigeration system, its operation and applications	04	06
03	<b>Refrigerants and Lubrication</b> 3.1 Classification of refrigerants 3.2 Types of refrigerants presently in use 3.3 Desirable properties of refrigerants (Physical, chemical, thermodynamic) 3.4 Applications of important refrigerants 3.5 Eco-friendly refrigerants 3.6 Properties of lubricants 3.7 Lubricants and refrigerant compatibility 3.8 Foaming of oil and crankcase electric heater 3.9 Effect of lubricant flood back to compressor 3.10 Additives used in lubricants 3.11 Necessity of oil separator	06	08
04	<b>Components of vapour compression system</b> 4.1 Various types of compressors – reciprocating (hermetic, semi sealed, open), rotary (centrifugal, lobe type, screw type, blade type), applications of each type 4.2 Various types of condensers (air cooled, water cooled, evaporative), applications 4.3 Types of cooling towers – natural draft, forced draft 4.4 Types of evaporators – direct expansion type, flooded type, shell and coil type, double tube type, plate surface type 4.5 Throttling devices – hand expansion valve, constant pressure expansion valve, thermostatic expansion valve, high side float valve, capillary tube, electronic expansion valve 4.6 Accessories – receiver, oil separator, drier, strainer, solenoid valve <b>Note</b> – schematic diagram and brief description only of the above components 4.7 Applications of refrigeration – Ice plant, water cooler, refrigerator, milk dairy, cold storage, breweries, superconductors, transport refrigeration and air conditioning	12	18

05	<p><b>Airconditioning</b></p> <p>5.1 Psychrometry – Definition, psychrometric properties of air, use of psychrometric chart</p> <p>5.2 Representation of simple air conditioning process on psychrometric chart.</p> <p>5.3 Sling psychrometer</p> <p>5.4 Airconditioning systems (Schematic layout, working and application of each of the following)</p> <ul style="list-style-type: none"> <li>• Central airconditioning system – direct expansion type, chilled water type</li> <li>• Package type airconditioning system</li> <li>• Unitary air conditioning system, split type system</li> <li>• Evaporative cooling</li> </ul> <p>5.5 Applications of airconditioning – comfort airconditioning, industrial airconditioning, transport air conditioning</p>	05	10
06	<p><b>Components in air supply and distribution system</b></p> <p>6.1 Fans and blowers (centrifugal, axial flow) – schematic diagram and applications</p> <p>6.2 Filters – (Dry, viscous, wet, electronic type) – schematic diagram and applications</p> <p>6.3 Different types of humidifiers and dehumidifiers</p> <p>6.4 Grills and registers</p> <p>6.5 Duct system – heat gain or loss in ducts</p> <p>6.6 Causes of pressure loss through air ducts</p> <p>6.7 Different methods of duct designing</p>	04	06
07	<p><b>Thermal insulation</b></p> <p>7.1 Desirable properties of insulating materials for airconditioning purpose</p> <p>7.2 Different types of insulating materials used for airconditioning</p> <p>7.3 Selection of insulating materials for walls, ceiling, floor, air ducts, chilled water pipes</p>	02	04
08	<p><b>Controls used in airconditioning</b></p> <p>8.1 High pressure and low pressure cutouts, overload protector, thermostat, oil safety switch, fusible plug, pressure equalizer</p> <p>8.2 Microprocessor based controls and variable frequency drive</p> <p>8.3 Fluid flow control devices (simple sketch and wiring diagram is expected)</p>	03	06
09	<p><b>Heat load</b></p> <p>9.1 Definitions – SHF, RSHF, EFSHF</p> <p>9.2 Factors responsible for heat load</p> <p>9.3 Conditions of airconditioning and representation of comfort zone on psychrometric chart</p> <p>9.4 Determination of capacity of airconditioning unit by referring tables only (no calculations)</p>	03	06

<b>10</b>	<b>Heating and ventilation</b> 10.1 Plain heating, electric heating, steam heating, hot water heating, solar heating 10.2 Heating with humidification and heating with dehumidification 10.3 Natural ventilation 10.4 Mechanical ventilation – 1) Air extraction system 2) Air supply system, combined supply and extraction system 10.5 Air distribution system – perimeter system, extended plenum system, upward flow system, downward flow system, ejector system 10.6 Return duct system (only schematic diagrams and brief description of the above system)	<b>07</b>	<b>12</b>
	<b>Total</b>	<b>48</b>	<b>80</b>

**Practical:**

Skills to be developed:

Intellectual Skills:

1. Interpret results
2. Write specifications

Motor Skills:

1. Conduct trial
2. Read drawing and identify components
3. Carry out Welding

**A) List of Practical:**

- 1) To carryout trial on vapour compression test rig for finding its performance.
- 2) To dismantle and assemble open type and hermetic type compressors, to draw freehand sketches of various parts and to write specifications of compressors.
- 3) To carryout copper tube welding
- 4) To study and draw block diagram of control panel wiring with respect to L.P. / H.P. cutouts, oil pressure cutout, thermostat, humidistat, solenoid valve
- 5) To troubleshoot the air-conditioning plant in relation to a) High condenser pressure b) Low cooling effect c) Reduced volume of supply of air d) compressor not starting
- 6) To prepare maintenance schedule of central air conditioning plant – weekly, quarterly, half yearly, yearly

**B) Demonstration:**

- a. Demonstration and study of various tools used in refrigeration such as – tube cutter, bending tools, flaring tool (block and yoke type), swaging tool, brazing tool, blow lamp etc.
- b. Demonstration of purging, gas charging, leak testing and pump down of the refrigeration system.

**C) Field work / Mini Project:**

- a. Imagine that you are going to purchase the window type airconditioner (assume suitable rating). Visit local market (if the market is not nearby you may use the Internet) and prepare a report based on the following points:  
Manufactures, Technical specifications, Features offered by different manufacturers, Price range  
Then select the airconditioner which you would like to purchase. Give justification for your selection in short.

**D) Visit:**

- a. Visit to airconditioned hotel or theater to study control panel and various controls, starting and stopping system, air supply and air return system. Write a detailed report.
- b. Visit to cold storage to study different components of vapour compression system, temperature and humidity conditions required for different food items.

Note: For mini projects and visits utilize professional practices periods

**Learning Resources:**

**Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
01	P. N. Anathanarayanan	Basic Refrigeration and Air-conditioning	Tata Mcgraw Hill, New Delhi
02	M. Adithan, S.C. Laroyia,	Practical Refrigeration and Air-conditioning	New Age International (P) Ltd.

**COURSE NAME : ELECTRICAL ENGINEERING GROUP**  
**COURSE CODE : EE/EP**  
**SEMESTER : SIXTH**  
**SUBJECT TITLE : ELECTRIC TRACTION - II (ELECTIVE III FOR EE)**  
**(ELECTIVE II FOR EP)**  
**SUBJECT CODE : 9144**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
03	--	02	03	80	20	--	25#	25@	150

**Notes:** Prerequisite for this subject is Electric Traction – I

**Rationale:**

Electric traction means a locomotion in which the driving force is obtained from electric motors. One of the practical applications of electricity, which enters into the everyday life of many of us, is its use in service of mass transport – the electric propulsions of vehicles – electric trains, trolley buses, tram cars and in the latest developments such as metro and sky bus.

**In view of the growing importance and technological developments, which have come about in this area in the recent past; for Electrical Engineering students, it is desirable to study the course dealing with electric traction. This subject belongs to technology area.**

**Objectives:**

The students will be able to,

- (1) List and explain different equipments used in the power circuit and auxiliary circuit of electric locomotives.
- (2) Explain importance of maintenance of electric locomotive.
- (3) State and explain functioning of the protection systems used in electric locomotives.
- (4) Describe the recent trends in electric traction; Such as, LEM propelled Traction.
- (5) Appreciate the use of computers in electric traction management.

**Learning Structure:**

Application

Use of electric traction as service for mass transport

Procedure

- (1) Study of operation/maintenance/control of different types of Electric locomotives.
- (2) Use of LIM for Traction.
- (3) Use of Computer in management of Traction.

Principle

- 1. Principle of LEM.
- 2. Principle of Magnetic Levitation
- 3. Principle of Protection System.

Facts

Electrical Machines, switchgears, Electrical Safety, Electrical Circuits and protection



**Contents: Theory:**

Chapter	Name of the Topics	Hours	Marks
01	<p><b>Electric Locomotives:</b></p> <p>1.1 - Nomenclature used For Electric Locomotives</p> <p>1.2 - Types of Electric Locomotives By Nomenclature.</p> <p>1.3 – AC Locomotive:</p> <p>1.3.1 - Equipments of AC Electric Locomotive:</p> <ul style="list-style-type: none"> <li>- Power Circuit Equipments and Auxiliary Circuit Equipments.</li> </ul> <p>1.3.2- Equipments in Power Circuit and their Functions:</p> <ul style="list-style-type: none"> <li>- Power Circuit Diagram of AC Locomotive: Pantograph, Circuit breaker, Tap Changer Traction Transformer, Rectifier, Smoothing Choke Traction Motor.</li> </ul> <p>1.3.3 - Equipments in Auxiliary Circuit &amp; their Functions: Head Light, Flasher Light, Horn, Marker Light, Batteries, Arno Converter, Blowers, Exhausters Compressors, Selsyn transformer.</p> <p>1.3.4 – List and Purpose of Different Type of Relays:</p> <p>1.3.5 – List and Purpose of Different Type of Contactors:</p> <p>1.4 – Three Phase Locomotive.</p> <p>1.4.1 – Power Circuit of Three Phase Locomotive.</p> <p>1.4.2 – Power Supply Arrangement for Auxiliary Machines in Three Phase Locomotive.</p>	14	20
02	<p><b>Maintenance of Locomotives:</b></p> <p>2.1 – Locomotive Maintenance</p> <p>2.2 – Need of Maintenance and Policy of Obselence.</p> <p>2.3 – Defects.</p> <p>2.4 – Ideal Maintenance:</p> <ul style="list-style-type: none"> <li>- Means to Improve the Reliability of Locomotive.</li> <li>- Means to Improve Availability of Locomotive.</li> <li>- Means to Reduce Maintenance Cost.</li> <li>- Maintenance Record.</li> <li>- Training Facility.</li> <li>- Characteristics of Efficient Maintenance.</li> </ul> <p>2.5 – Electrical Faults and Their Causes.</p> <p>2.6 – Fault Localisation.</p> <p>2.7 – Necessity of Testing.</p> <ul style="list-style-type: none"> <li>- Testing Procedure.</li> <li>- Individual Equipment Tests.</li> </ul>	10	20
03	<p><b>Protection of Electric Locomotive:</b></p> <p>3.1 – Introduction.</p> <p>3.2 – Broad Strategy For Protection.</p> <p>3.3 – Surge Protection:</p> <ul style="list-style-type: none"> <li>- Direct Lightening Strokes.</li> <li>- Switching Surges: External and Internal.</li> </ul> <p>3.4 – Overload Protection of Main Power Circuit.</p> <p>3.5 – Earth Fault Protection of Power and Auxiliary Circuit.</p>	08	16

	<p>3.6 – Protection from Over Voltage and Under Voltage.  3.7 – Differential Current Protection of Traction Circuits.  3.8 – Protection Against High and Low Air Pressure in the Compressed Air Circuit.  3.9 – Temperature Monitoring.  3.10 – Protection of Transformer By Buchholz’s Relay.  3.11 – Monitoring of Ventilation System of Key Locomotive Equipments.  3.12 – Protection Against Accidental Contact with HT Equipment.  3.13 – Protection Against Fire.  - Fire Prevention Strategy.</p>		
<b>04</b>	<p><b>LEM Propelled Traction:</b>  4.1 – Introduction.  4.2 – Linear Electric Motor (LEM)  4.3 – Linear Induction Based Traction System:  - Moving Primary Fixed Secondary Single Sided LIM.  - Moving Secondary Fixed Primary Single Sided LIM.  - Moving Primary Fixed Secondary Double Sided LIM.  4.4 – Strengths/Weaknesses of LIM Propelled Railway Traction:  - Strengths of LIM Propelled Railway Traction System.  - Weaknesses of LIM Propelled Railway Traction System.  4.5 – Practical Possibilities of LIM Propelled Transportation.  4.6 – Inputs/Modifications for Adoption of LIM Propulsion in the Existing System:  - Track Modification.  - Vehicle Modification.  - Voltage and Speed Control.  4.7 – LIM Propelled Underground Metro Rail System:  - Factors Influencing Adoption of LIM for Metro Rail.  - International Scenario.  4.8 – Wheel Less Traction:  - Levitation Schemes.  - Present Scenario.</p>	<b>10</b>	<b>12</b>
<b>05</b>	<p><b>Application of Computers in Management of Electric Traction:</b>  5.1 – Introduction.  5.2 – Computer’s Capability Relevant to Electric Traction Management.  5.3 – Areas of Computer Application in Traction System Management:  - Optimisation of OHE and Power Supply Installation Designs.</p>	<b>06</b>	<b>12</b>

	<ul style="list-style-type: none"> <li>- Computer Aided Locomotive Designs.</li> <li>- Monitoring of Maximum Demand.</li> <li>- Energy Saving Driving Approach.</li> <li>- Training of Drivers on Simulators.</li> <li>- Aiding Drivers and Maintenance Depot Through On Board Computers</li> <li>- History of Locomotive and OHE Equipment.</li> <li>- Failure Analysis.</li> <li>- Monitoring Execution of Trip Inspection Schedules of Locomotives.</li> <li>- Inventory Control.</li> </ul> <p>5.4 – Possible Other Areas for Computer Controlled Monitoring.</p> <p>5.5 – Advantages of Use of Computers for Management of Electric Traction System.</p>		
<b>Total</b>		<b>48</b>	<b>80</b>

**Assignments:**

**Drawing Sheets:**

(i) Drawing (on half Imperial sheet) for Power Circuit of any type of Electric Locomotive

(ii) Drawing (on half Imperial sheet) for Protection of Electric Locomotive.

( **Note:** Students should be able to identify, explain the functions of various equipments used in Electric locomotive).

**Mini Project:**

Collection of information using Internet on any two topics in the contents and submission of printouts

**Learning Resources:**

**Books:**

Sr. No.	Author	Title	Publisher
1.	H. Partab	Modern Electric Traction	Dhanpat Rai & Sons
2.	J. Upadhyay S. N. Mahendra	Electric Traction	Allied Publishers Ltd.
3.	Om Prakash Kesari	Viddut Engine Parichay (In Hindi)	S. P. Graphics, Nashik. Phone No. (0253) 2580882

**Course Name** : Electrical Engineering Group  
**Course Code** : EE/EP  
**Semester** : Sixth  
**Subject Title** : Repairs and Maintenance of Electrical Equipment  
 (Elective- III for EE and Elective II for EP)  
**Subject Code** : 9145

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
03	--	02	03	80	20	--	25#	25@	150

**Rationale:**

This subject is classified as technology subject which intends to have hands on experience in handling, maintaining, repairing, estimating & costing for repairs of various electrical equipments used in domestic , & commercial fields.

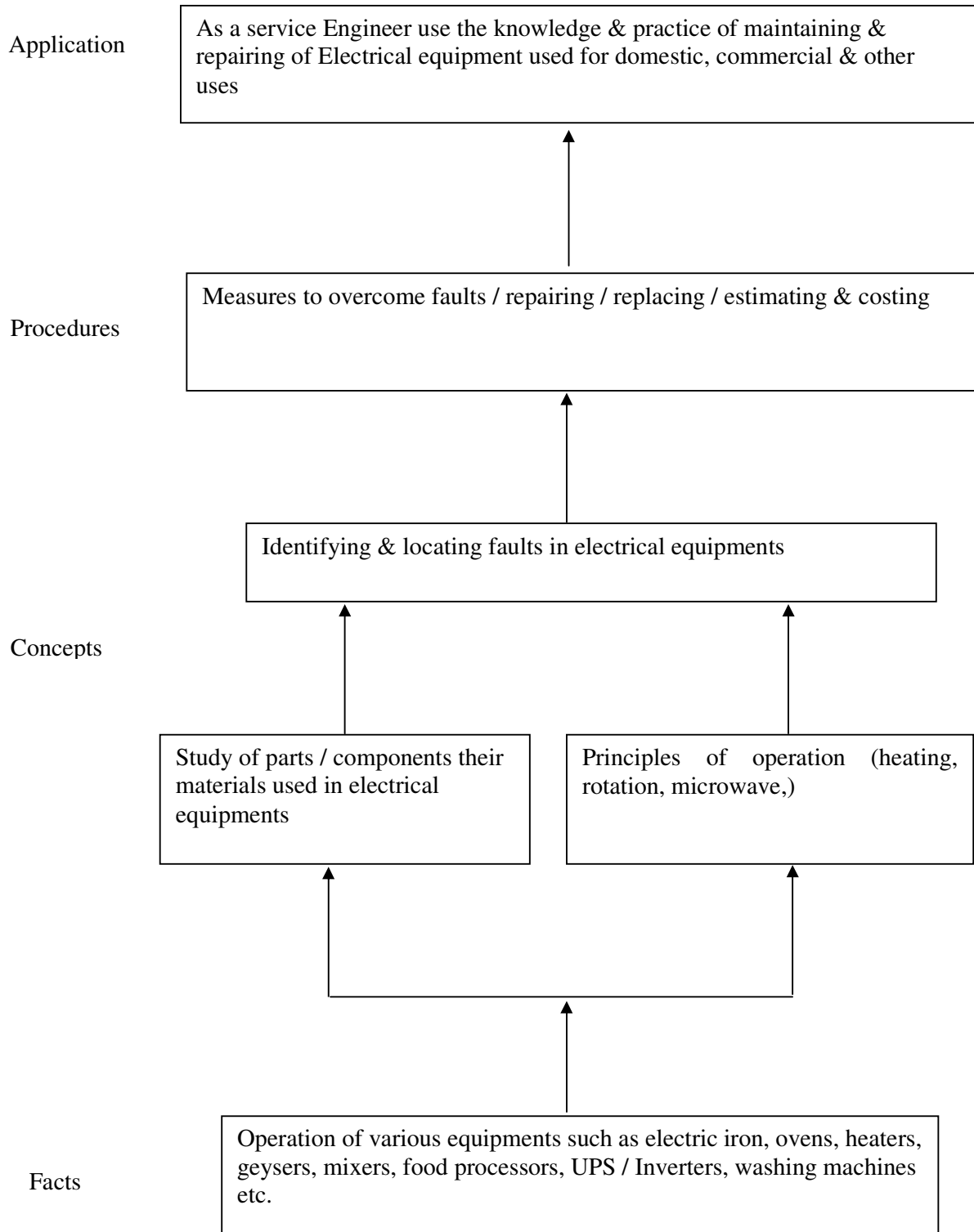
This will enable him to be a self-entrepreneur & can get job as sales & service engineer.

**Objective:**

The student will be able to:

1. Test different electrical equipments as per I S.
2. Prepare cost & estimate of repairs & selection of components.
3. Identify faults & measures to repair faults.
4. Identify specific tools for maintenance.
5. To select appropriate UPS / Inverters for given application.

**Learning Structure:**



## Contents: Theory

Chapter	Name of the Topic	Hours	Marks
1	Introduction Principle different effects of electric currents, materials used in electrical equipments, tools / instruments necessary for repair works, jointing methods, soldering, testing of instruments, Interpretation, location & identification of faults, recording / estimation of materials / components required & their cost, approximate costing of repair of equipment.	08	14
2	Domestic electrical equipment, Principle, types, construction, operation, testing, fault finding, dismantling, assembly & testing after repairs of following equipments electric Iron all types, electric ovens, electric fans & regulators, water heaters, geysers mixers, food processors, toasters.	16	26
3	Circuits used for control & regulation of electronic circuits like rectifiers amplifier timer, oscillator, identification of component, component testing, with multimeters replacement of components, microwave & use microwave for heating, laser & laser equipment	08	14
4	Advanced equipments principle, types, construction, operation, Testing, fault finding, dismantling, assembly & testing after repairs of following equipments- UPS / Inverters, battery chargers, microwaves ovens, air coolers, washing machines – semi automatic / fully automatic, remote controllers of different equipments, VCD / DVD / ACD players.	16	26
<b>Total</b>		<b>48</b>	<b>80</b>

### Practical:

Skills to be developed:

Intellectual Skills:

1. Analytical Skills
2. Identification Skills
3. Fault finding Skills

Motor Skills:

1. Measuring Skill
2. Connecting instruments
3. Proper use of instruments, tools for repairs

### **A) Laboratory Experiences:**

#### **Dismantling, assembly, testing, preparation of list of components, parts and their cost for:**

- 1) Electric iron all types
- 2) Electric oven
- 3) Electric toasters
- 4) Electric fan (CF, TF, PF, & EF & regulators)
- 5) Water heaters & geysers
- 6) Mixer & food processors
- 7) UPS / Inverters / battery chargers
- 8) Air coolers ( portable / desert type)
- 9) Semi automatic & fully automatic washing machine
- 10) VCD / DVD / AVD players
- 11) Microwave Ovens
- 12) All types remote controllers

### **B) Field work:**

- 13) Visit servicing centers of manufacturing companies , write the procedure of servicing of any one of them
- 14) Visit a manufacturing unit & prepare a report based on it.

### **C) Mini project:**

- 15) For given specific application of any two equipments collect literature of different manufacturing company & prepare a comparative chart
- 16) Prepare test reports & bills for servicing of above any two equipments.

### **Learning Resources:**

1. Service Manuals of manufacturers

**Course Name : Electrical Engineering group**

**Course Code : EE/EP**

**Semester : Sixth**

**Subject Title : Microprocessors and Microcontrollers (Elective II for EP and Elective-III for EE)**

**Subject Code: 9147**

**Teaching and Examination Scheme:**

Teaching Scheme			<i>Examination Scheme</i>						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
03	--	02	03	80	20	--	25#	25@	150

**Rationale:**

Today microprocessors and microcontrollers have become an integral part of all automatic and semi automatic machines. Therefore there is a growing need of engineers / technicians in this field. Hence, it is necessary to study microcontroller basics, hardware and its programming.

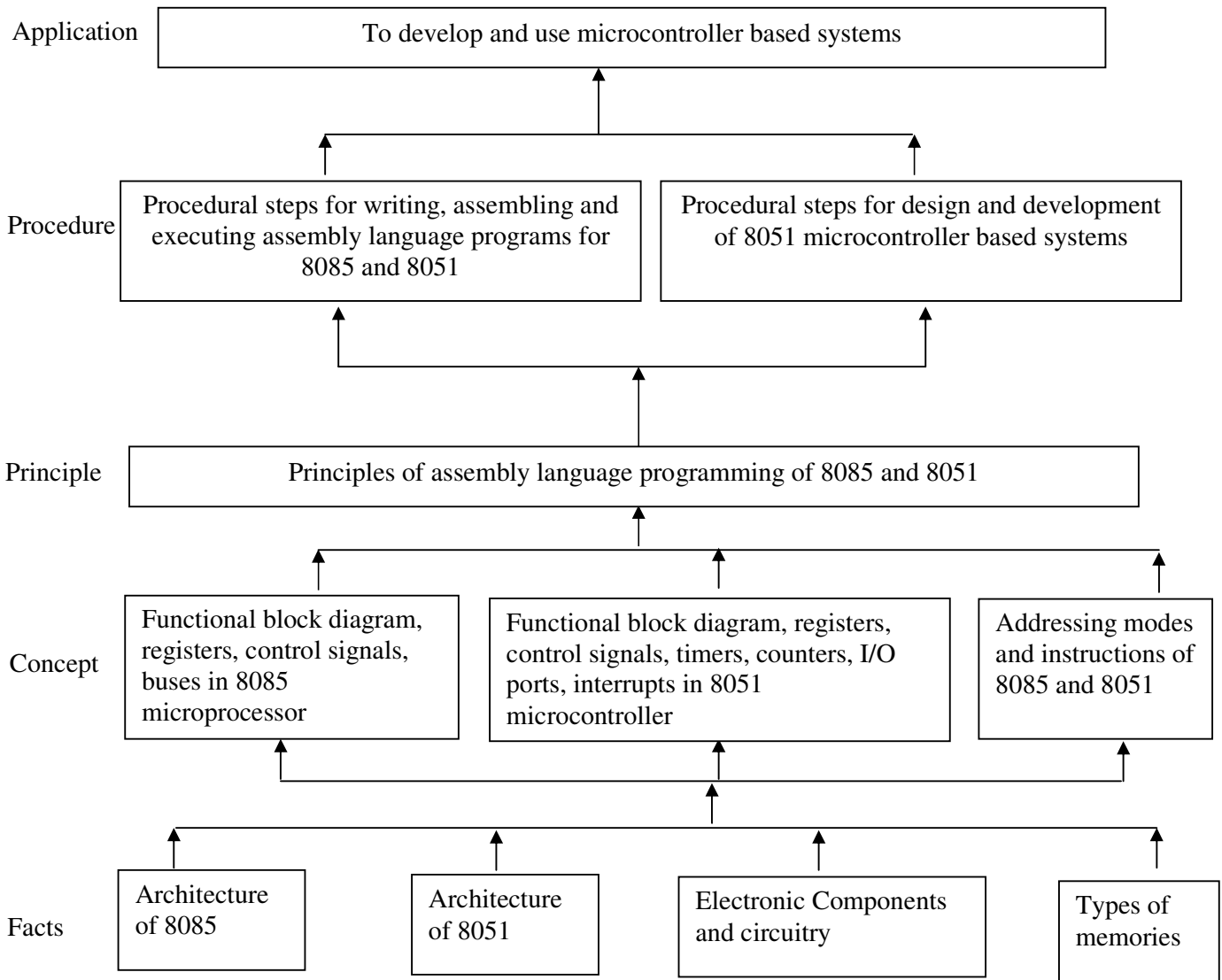
This subject covers microprocessor 8085 and microcontroller 8051 architecture, its instruction set, programming and applications. After completing this subject the student can write and execute programs for microcontroller and microprocessor based applications.

**Objectives:**

The student will be able to

1. Describe architecture and operation of microprocessor 8085
2. Develop assembly language programs using instruction set of 8085
3. Describe architecture and operation of microcontroller 8051
4. Develop assembly language programs using instruction set of 8051
5. Design and develop microcontroller based systems
6. Explain various applications of microcontrollers

## Learning Structures:



**Contents: Theory**

<b>Chapter</b>	<b>Name of the Topic</b>	<b>Hours</b>	<b>Marks</b>
<b>01</b>	<b>Microprocessor 8085</b> 1.1 Evolution of microprocessors 1.2 Architecture of 8085 1.3 Pin diagram 1.4 Control signals 1.5 Mmultiplexing of address & Data Bus	<b>06</b>	<b>10</b>
<b>02</b>	<b>8085 Assembly Language Programming</b> 2.1 Programming Model of 8085 2.2 Addressing Modes 2.3 Instruction classification, Instruction format 2.4 Instruction set 2.5 Stacks & subroutines 2.6 Assembly Language programming	<b>08</b>	<b>14</b>
<b>03</b>	<b>Microcontroller Basics</b> 3.1 Introduction and applications 3.2 Comparison between microcontrollers and microprocessors 3.3 Evolution of microcontrollers 3.4 Commercial microcontroller devices	<b>02</b>	<b>04</b>
<b>04</b>	<b>8051 Architecture</b> 4.1 Block diagram of 8051 microcontroller 4.2 Registers in 8051 4.3 General purpose or working registers 4.4 Stack Pointer and Program counter 4.5 Special function registers (SFR) 4.6 Program Status word 4.7 Data pointer (DPTR) 4.8 Timer resisters 4.9 Ports 4.10 Control registers	<b>05</b>	<b>08</b>
<b>05</b>	<b>8051 connections, I/O ports and memory organization</b> 5.1 8051 pin description 5.2 8051 connections 5.3 Parallel I/O ports 5.4 Memory organization	<b>05</b>	<b>08</b>
<b>06</b>	<b>8051 addressing modes and instructions</b> 6.1 8051 addressing modes 6.2 8051 instruction set 6.3 8051 assembler and assembling 8051 program 6.4 Software simulators of 8051 6.5 8051 instructions and simple programs	<b>08</b>	<b>12</b>
<b>07</b>	<b>8051 interrupts, timer/counters and serial communication</b> 7.1 Interrupts in 8051 7.2 Initializing 8051 interrupts 7.3 Interrupt priorities 7.4 Timers and counters, timer counter modes 7.5 Serial communication, serial communication modes	<b>06</b>	<b>10</b>

<b>08</b>	<b>Applications of microcontrollers</b> 8.1 Square wave and rectangular wave generation 8.2 Pulse generation 8.3 Pulse width modulation 8.4 Frequency counter 8.5 Interfacing small keyboards 8.6 Interfacing LCD display, 8.7 Interfacing D/A and A/D converters 8.8 Interfacing relay 8.9 Interfacing stepper motor 8.10 Interfacing DC motor.	<b>08</b>	<b>14</b>
	<b>Total</b>		

**Practical:**

Intellectual Skills:

1. Logical development
2. Programming skills

Motor Skills:

1. Data entry, Error Correction and Execution of assembly language programmes
2. Connection Skills

**List of Practicals:**

Using microprocessor 8085 kit:

1. Demonstration and study of microprocessor kit
2. Program for addition of and subtraction of two hexadecimal numbers
3. Program for finding largest / smallest number
4. Program for arranging numbers in ascending / descending order
5. Program for 16 bit addition
6. Program for data masking
7. Program for multiplication of two eight bit numbers
8. Program using JMP Instruction
9. Two programs using loop & Counter

Using microcontroller 8051 kit:

1. Demonstration and study of microcontroller kit
2. Demonstration and use of software simulator / assembler
3. Programming examples (any two) – Data transfer instructions
4. Programming examples (any two) – Logical Operations
5. Programming examples (any two) – Jump and Call instructions
6. Demonstration and testing of the following applications (Any four)
  - Keyboard Interface
  - LCD display Interface
  - D/A or A/D converter Interface
  - Relay Interface
  - Stepper motor control
  - DC motor control
  - Any other practical application using microcontroller 8051

**Learning Resources:****Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publisher</b>
01	Ajay V Deshmukh	Microcontrollers theory and applications	TMH, New Delhi
02	Kenneth J Ayala,	8051 microcontrollers architecture, Programming and Applications	International Thomson publishing, India
03	B. Ram	Microprocessor & Microcomputer	S. Chand publications
04	Ramesh Gaonkar	Microprocessor Architecture, Programming, and Applications with the 8085	Penram International Publishing (India) Pvt. Ltd.

**Course name : Electrical Engineering Group**

**Course Code : EP / EE**

**Semester : Sixth**

**Subject Title : Power System Operation & Load Dispatch EP (Compulsory) EE (Elective-III)**

**Subject Code : 9148**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS.	TH	TEST	PR	OR	TW	TOTAL
03	--	02	03	80	20	--	25#	25@	150

**Rationale:**

Power System Engineer will play an important role in operation of power system, which is large in size & complex in nature. Hence the knowledge of operational analysis & system stability is essential.

For learning this subject, knowledge of power generation, transmission & distribution system, switch gears, protection schemes & utilization is required.

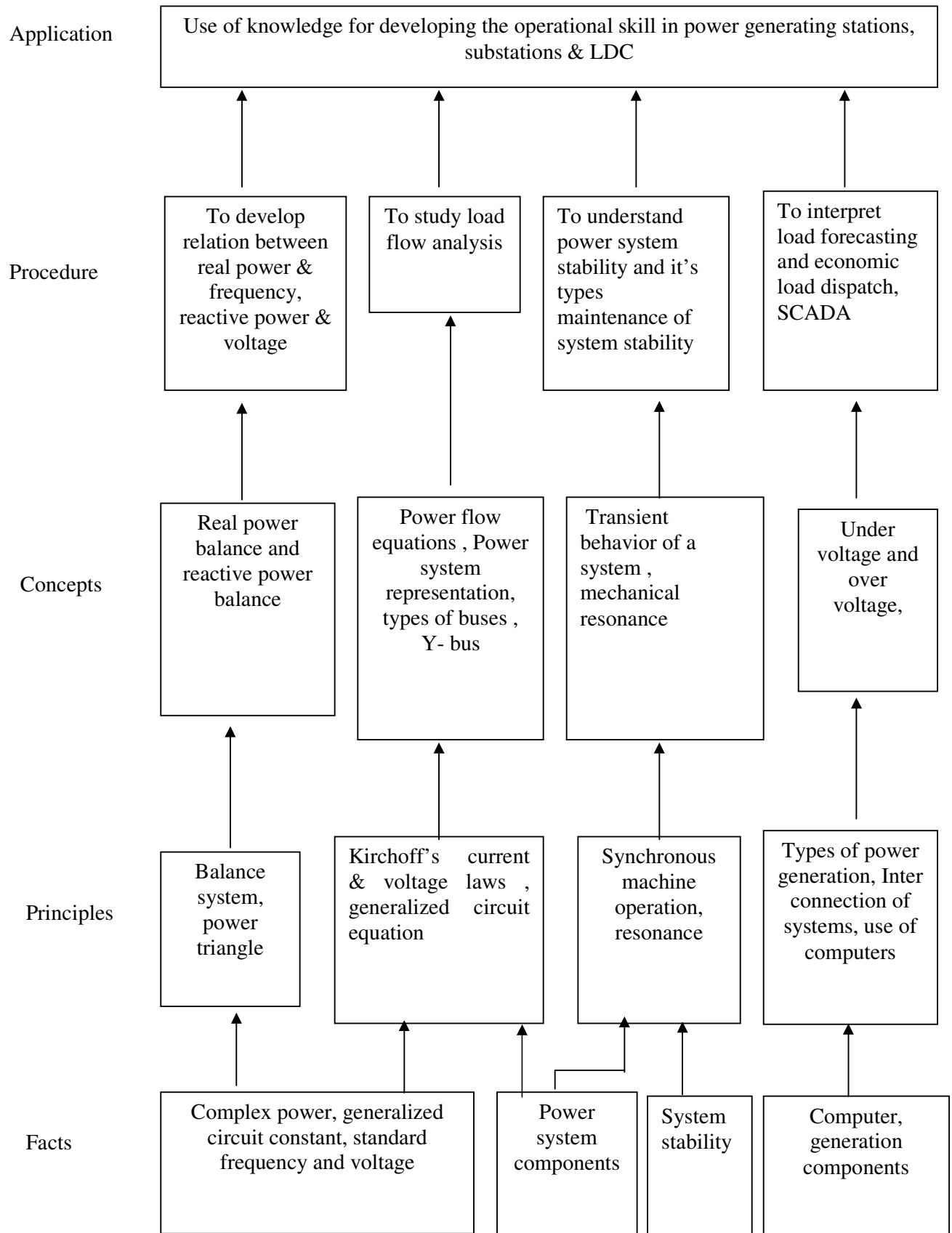
This subject deals with cause of change in frequency & change in voltage & also automatic excitation & governor control for maintenance of power system stability.

**Objectives:**

Students will be able to:

1. Appreciate the significance of real power & reactive power flow in the system.
2. Identify the causes of Power Failure
3. Describe the importance of system stability.
4. Describe concept of load flow analysis.
5. Write Y – bus vector configuration.
6. Explain function & Operation of load dispatch center.

**Learning Structure:**



## Contents: Theory

Chapter	Name of the Topic	Hours	Marks
01	<b>Real &amp; Reactive power flow control</b> 1.1 Review of power flow in power system 1.1.1 Types of consumers. 1.1.2 Types of power plants. 1.2 Generation & Load balance 1.2.1 Real power flow balance 1.3 Real power & frequency dependence 1.3.1 Derive relation for a simple 2-bus system. 1.3.2 Effect of change in frequency on various consumers. 1.3.3 Effect of change in frequency in utilities. 1.3.4 Load frequency control. 1.3.5 Schematic diagram of load frequency control of Turbo generator. 1.3.6 Turbine speed governing system (AGC) (automatic frequency control using primary & secondary loops. 1.4 Reactive power & voltage dependence. 1.4.1 Derive relation for simple 2-bus system. 1.4.2 Effect of change in voltage. 1.4.3 Automatic Excitation control. 1.4.4 Concept of Reactive power compensation. 1.4.5 Types of Reactive power compensating equipments and their field of application.	10	14
02	<b>Load Flow Analysis</b> 2.1 Need of load flow analysis 2.2 Important Aspects of load flow analysis 2.3 Data required for load flow analysis 2.4 Classification of bus, formation of Y-bus 2.5 Derivation of SLFE equation for a simple Two Bus system 2.6 Numerical for 3 bus system including reference bus (for formation of $Y_{bus}$ ) 2.7 Characteristics of SLFE 2.8 Information obtained from SLFE 2.9 Constraints of SLEF	12	26

03	<p><b>Power System Stability</b></p> <p>3.1 Introduction</p> <p>3.1.1 Causes of disturbance in power system</p> <p>3.1.2 Condition &amp; necessity of synchronization of alternators.</p> <p>3.1.3 Need of interconnection of power system network</p> <p>3.1.4 Concept of stability with reference to synchronous machine operation.</p> <p>3.2 Power angle curve</p> <p>3.3 Types of stability</p> <p>3.3.1 Steady state stability</p> <p>3.3.2 Derivation of maximum steady state power flow &amp; condition.</p> <p>3.4 Transient state stability</p> <p>3.4.1 Causes</p> <p>3.4.2 Representation in power angle diagram</p> <p>3.4.3 Techniques for improving transient stability (conceptual level only)</p> <p>3.5 Concept of dynamic state stability &amp; its effect (No Numerical)</p>	12	20
04	<p><b>Concept of load dispatching</b></p> <p>4.1 Schematic of regional interconnected grids in India</p> <p>4.2 Types of LDS &amp; their significance</p> <p>4.3 Functions of LDS</p> <p>4.3.1 Load forecasting</p> <p>4.3.1.1 Need of forecasting</p> <p>4.3.1.2 Planning tools</p> <p>4.3.1.3 Forecasting based on load curves</p> <p>4.3.1.4 Environmental &amp; social factors in load forecasting</p> <p>4.3.2 Load shedding</p> <p>4.3.2.1 What is load shedding &amp; its governing factors.</p> <p>4.4 SCADA</p> <p>4.4.1 Components &amp; their functions</p> <p>4.4.2 Applications of SCADA at LDS</p>	10	16
05	<p><b>Optimum operating strategy</b></p> <p>5.1 Generation mix</p> <p>5.2 Optimum dispatch</p> <p>5.3 Economic dispatch</p> <p>5.3.1 Cost function</p> <p>5.3.2 Generator operating cost</p> <p>5.3.3 Optimal operation (Numerical)</p> <p>5.3.4 Distribution of load within the plant &amp; between the plants (simple numerical) No derivation on above topics</p>	04	04
<b>Total</b>		<b>48</b>	<b>80</b>

**Practical:**

**Skills to be developed:**

**Intellectual Skills:**

1. Knowledge Recalling Skill
2. Identification Skill
3. Interpretation Skill
4. Planning Skill
5. Information Searching skill

**Motor Skills:**

**Drawing Skill**

**Assignments:**

<b>01</b>	<b>Visit To Power Plant &amp; Report Writing</b> <ul style="list-style-type: none"><li>• Draw schematic diagram &amp; layout.</li><li>• Write different components of power plant &amp; their functions.</li><li>• Describe different controls in operation of power plant like AGC/frequency control/voltage control.</li><li>• Study different disturbances in the station &amp; how system can be restored.</li><li>• Study different types of stability.</li></ul>
<b>02</b>	<b>Visit to load dispatch station &amp; report writing</b> <ul style="list-style-type: none"><li>• Study different components of LDS.</li><li>• Study and operation of SCADA.</li><li>• Study control of real &amp; reactive power in LDS on monitor ( online).</li><li>• Understand the effect of load shedding through single line diagram on monitor.</li><li>• Analyze the incentive &amp; penalty for the change of frequency.</li></ul>
<b>03</b>	<b>Load flow analysis (practical session for numerical)</b> <ul style="list-style-type: none"><li>• Take suitable examples on –<ul style="list-style-type: none"><li>○ Study of simple three bus system.</li><li>○ Formation of Y- bus.</li><li>○ SLFE equations.</li></ul></li></ul>
<b>04</b>	<b>Study Of Different Equipments Of Voltage Control</b> <ul style="list-style-type: none"><li>• Draw diagrams of equipments.</li><li>• Describe working of them.</li></ul>
<b>05</b>	<b>Study of different Reactive power compensating equipments</b> <ul style="list-style-type: none"><li>• Draw diagram &amp; describe working of each.</li><li>• Case study of some industry in which these equipments are installed.</li><li>• Study the improvement in p.f. in above industry equipments by reactive power compensation.</li></ul>
<b>06</b>	Study different Tariffs & collect information about it & write a report on different Tariff structures.
<b>07</b>	Collect seminar papers on any topic related to subject given by experts in conferences or published in journals / magazines & write brief report on it.

**Learning Resources:****Books:**

<b>Sr. No.</b>	<b>Author</b>	<b>Title</b>	<b>Publication &amp; Address</b>
01.	I. J. Nagrath & D. P. Kothari	Power system Engineering	Tata McGraw Hill Publication
02.	A. S. Pabla	Electrical Power system Planning	Macmillan India Ltd. New Delhi
03.	Olle. L. Elgerd	Electrical Energy System	Tata McGraw Hill Publication
04.	John J. Graninger & Wiliam StevensonJR	Power system Analysis	Tata McGraw Hill Publication
05.	Wiliam Stevenson	Elements Power system Analysis	McGraw Hill Bork company

**COURSE NAME : ELECTRICAL ENGINEERING GROUP**  
**COURSE CODE : EE/EP**  
**SEMESTER : SIXTH**  
**SUBJECT TITLE : INDUSTRIAL PROJECTS**  
**SUBJECT CODE : --**

**Teaching and Examination Scheme:**

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

**Note :- Actual work of project should be done, on the project selected in fifth semester.**

**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.

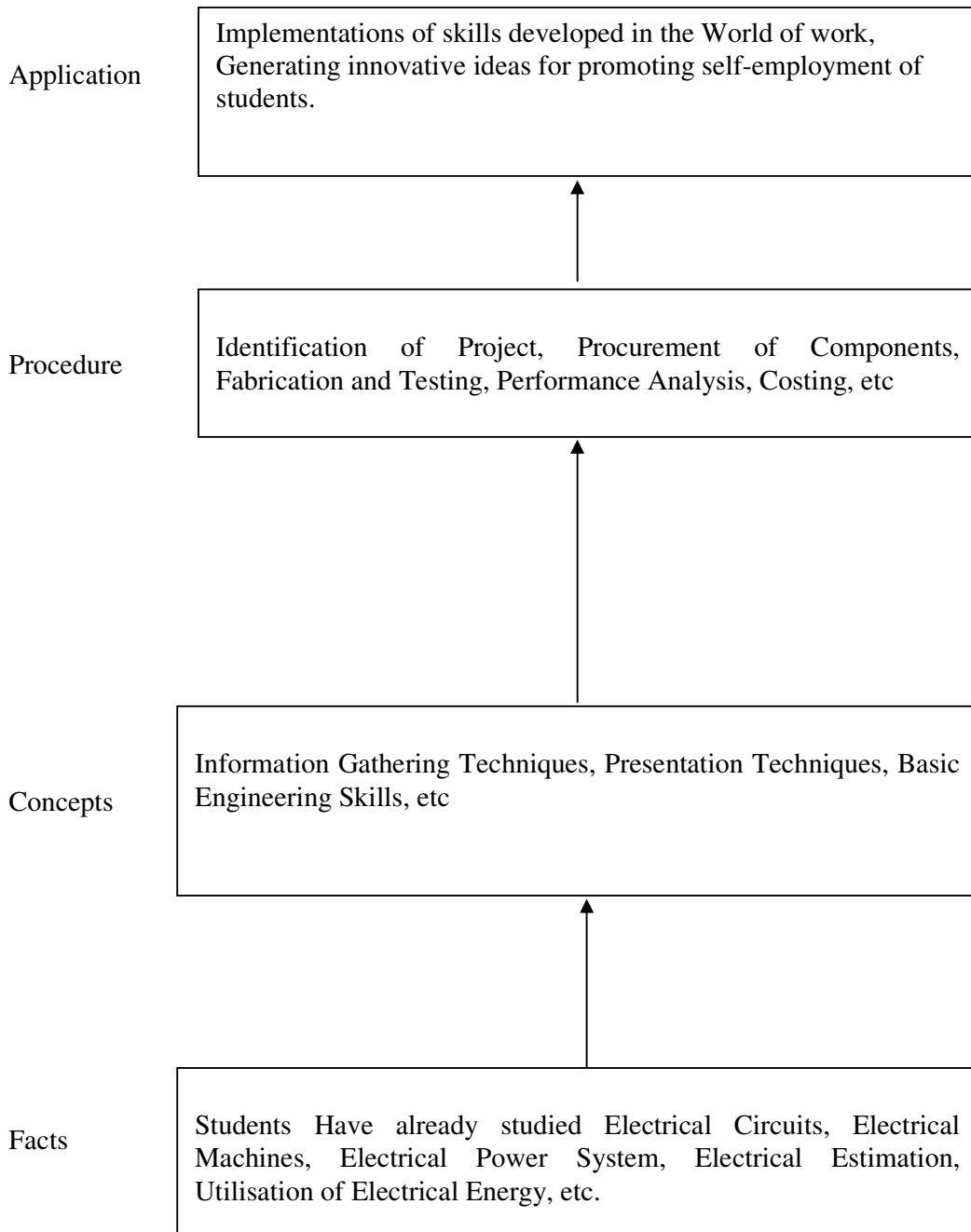
This subject is intended to teach students to understand facts, concepts and techniques of electrical equipments, its repairs, fault finding and testing, estimation of cost and procurement of material, fabrication and manufacturing of various items used in electrical field. This will help the students to acquire skills and attitudes so as to discharge the function of supervisor in industry and can start his own small-scale 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 Innovative ideas.
5. Develop basic technical Skills by hands on experience.
6. Write project report.
7. Develop skills to use latest technology in Electrical field.

**Learning Structure:**



**Contents:**

Two hours should be allotted for giving the Instructions for preparing a Project Report.  
(Refer Guideline Document for Format of Project Report)

<b>Projects</b>	
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.	
11. Fabrication of Battery Charger.	
12. Fabrication of Small Wind Energy System for Battery Charging.	
13. Fabrication of Solar Panel System for Battery Charging.	
14. Microprocessor/ Micro controller Based Projects.	
15. PC Based Projects.	
16. Simulation Projects.	
<b>Seminar</b>	
Seminar on any relevant latest technical topic based on latest research, recent trends, new methods and developments in the field of Electrical Engineering / Power Electronics.	

**Note:** (1) One Project            (2) Seminar will be held under Professional Practices.

**Learning Resources:****1. Books/Magazines:**

<b>Sr. No.</b>	<b>Name of the Magazine</b>
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

## **2. Website:**

Using any search engine, such as <http://www.google.co.in/> the relevant information can be searched on the Internet.

**COURSE NAME : ELECTRICAL ENGINEERING GROUP**  
**COURSE CODE : EE/EP**  
**SEMESTER : SIXTH**  
**SUBJECT TITLE : PROFESSIONAL PRACTICES-VI**  
**SUBJECT CODE : --**

**Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme						
TH	TU	PR	PAPER HRS	TH	TEST	PR	OR	TW	TOTAL
--	--	05	--	--	--	--	--	50@	50

**Rationale:**

Most of the diploma holders join industries. Due to globalization and competition in the industrial and service sectors the selection for the job is based on campus interviews or competitive tests.

While selecting candidates a normal practice adopted is to see general confidence, attitude and ability to communicate and attitude, in addition to basic technological concepts.

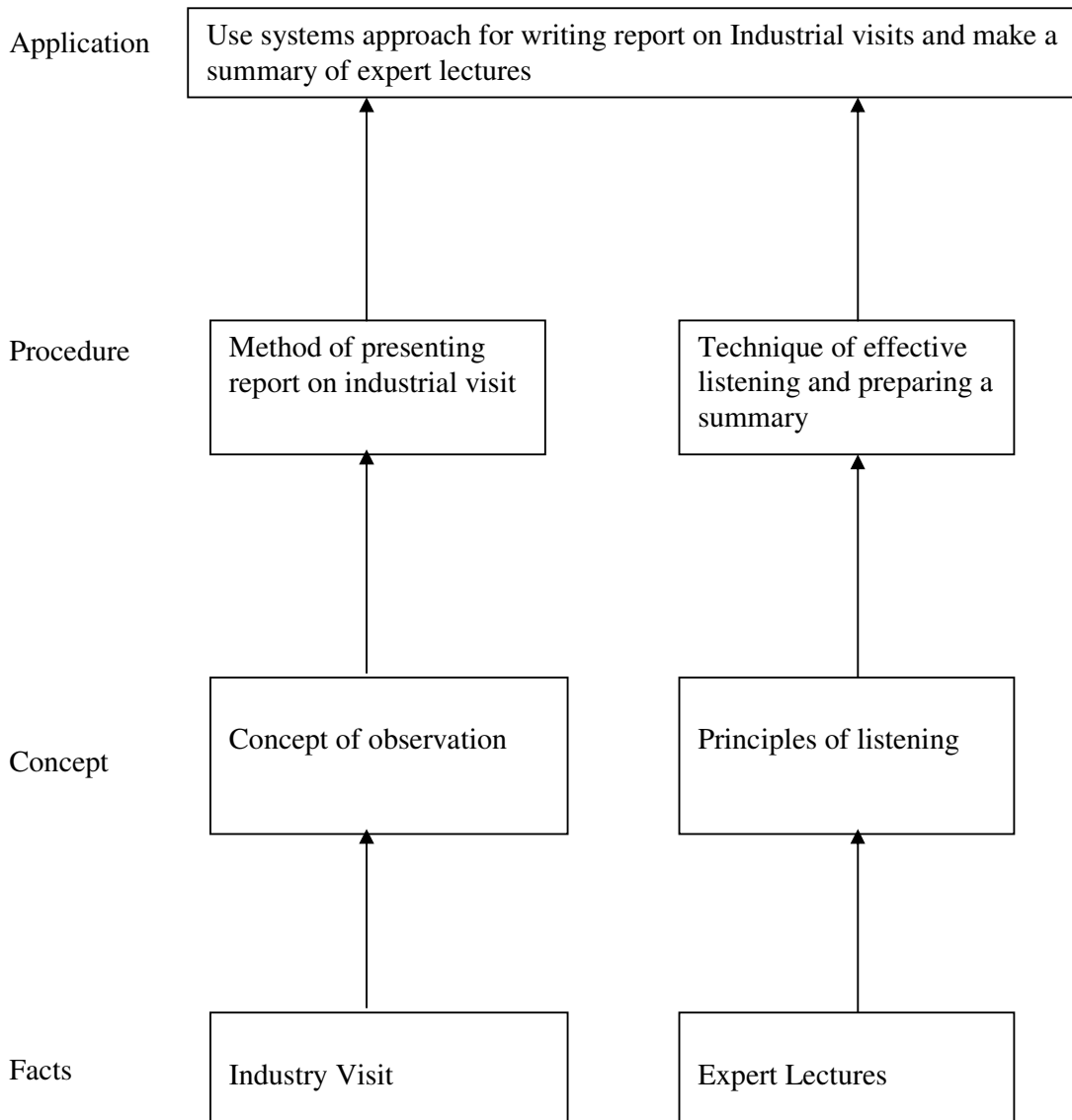
The purpose of introducing professional practices is to provide opportunity to students to undergo activities which will enable them to develop confidence. Industrial visits, expert lectures, seminars on technical topics and group discussion are planned in a semester so that there will be increased participation of students in learning process.

**Objectives:**

Student will be able to:

1. Acquire information from different sources.
2. Prepare notes for given topic.
3. Present given topic in a seminar.
4. Interact with peers to share thoughts.
5. Prepare a report on industrial visit, expert lecture.

**Learning Structure:**



Sr. No.	Activity	Hours
01	<p>Structured industrial visits shall be arranged and report of the same should be submitted by the individual student, to form a part of the term work. (minimum 3 visits)</p> <p>Following are the suggested type of Industries/ Fields -</p> <ul style="list-style-type: none"> <li>i) Visit to Load Dispatch Center.</li> <li>ii) Visit to Transformer Repair Workshop.</li> <li>iii) Visit to Electrical Machine Manufacturing Unit.</li> <li>iv) Visit to Industry of Power Electronics Devices.</li> <li>v) Visit to Maintenance Department of Large Industry.</li> <li>vi) Visit to Multi Storied Building.</li> <li>vii) Visit to Loco Shade.</li> </ul>	21
02	<p>The Guest Lecture/s at least two of two hours duration each from field/industry experts, professionals are to be arranged from the following or alike topics. The brief report to be submitted on the guest lecture by each student as a part of Term work</p> <ul style="list-style-type: none"> <li>a) New Trends in Power Electronics Devices</li> <li>b) Eco friendly Air Conditioning/Refrigeration</li> <li>c) TQM</li> <li>d) Recent Modifications in IE Rules</li> <li>e) Functioning of Electricity Regulatory Commission</li> <li>f) Fourth Stage of Koyana Hydro Station</li> <li>g) Recent trends in Power Generation</li> </ul>	14
03	<p>Information Search ,data collection and writing a report on the topic</p> <ul style="list-style-type: none"> <li>a) Collection of data for comparison of Transformer Companies</li> <li>b) Latest trend in Classification of Insulating materials</li> <li>c) Design Considerations for Manufacture of Dry Type Transformers</li> <li>d) State and National Statistics for Power Generation</li> <li>e) Comparison of Cost per unit generated by various methods of Power Generation</li> <li>f) Safety considerations for Generation</li> </ul>	15
04	<p>The students should discuss in group of six to eight students and write a brief report on the same as a part of term work. The topic of group discussions may be selected by the faculty members. Some of the suggested topics are -</p> <ul style="list-style-type: none"> <li>i) Role of Electrical Engineer in disaster management.</li> <li>j) Scope of out sourcing of Electrical Engineering services.</li> <li>k) Pollution control.</li> </ul>	14
05	<p>Seminar Presentation</p> <p>The students should select a topic for <b>Seminar</b> based on recent developments in Electrical engineering field, emerging technology etc.</p>	16
<b>Total</b>		<b>80</b>