


<div> MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</div> <div>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</div>																	
COURSE NAME : DIPLOMA IN ELECTRICAL POWER SYSTEM																	
COURSE CODE : EP																	
DURATION OF COURSE : SIX SEMESTERS										WITH EFFECT FROM 2012-13							
SEMESTER : FIFTH										DURATION : 16 WEEKS							
PATTERN : FULL TIME - SEMESTER										SCHEME : G							
SR. NO	SUBJECT TITLE	abbrevi ation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17500)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
Max	Min	Max	Min	Max	Min	Max		Min									
1	Energy Conservation & Audit	β	ECA	17506	03	--	02	03	100	40	--	--	--	--	25@	10	50
2	Industry Electrical Systems-II	β	IES	17507	04	--	--	03	100	40	--	--	--	--	--	--	
3	Switchgear & Protection	β	SAP	17508	03	--	02	03	100	40	--	--	--	--	25@	10	
4	Power System Analysis		PSA	17510	03	--	02	03	100	40	--	--	--	--	50@	20	
5	A.C. Machines	β	ACM	17511	03	--	02	03	100	40	50#	20	--	--	25@	10	
6	Behavioural Science	\$	BSC	17075	01	--	02	--	--	--	--	--	25#	10	25@	10	
7	Entrepreneurship Development & Project	β	EDP	17059	01	01	02	--	--	--	--	--	--	--	25@	10	
8	Professional Practices - III / Industrial Training (Optional)**	β	PPT	17060	--	--	03	--	--	--	--	--	--	--	50@	20	
Total					18	01	15	--	500	--	50	--	25	--	225	--	50
Student Contact Hours Per Week: 34 Hrs.																	
THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.																	
Total Marks : 850																	
@ - Internal Assessment, # - External Assessment, <div></div> 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 : Electrical Engineering Group**Course Code : EE / EP****Semester : Fifth****Subject Title : Energy Conservation and Audit****Subject Code : 17506****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:

Technological development in all sectors has caused imbalance in energy generation and its consumption. Energy conservation is a scientific tool provided to minimize the energy imbalance. This is one of the rapid emerging field in the area of electrical engineering hence this has been included as core technology subject.

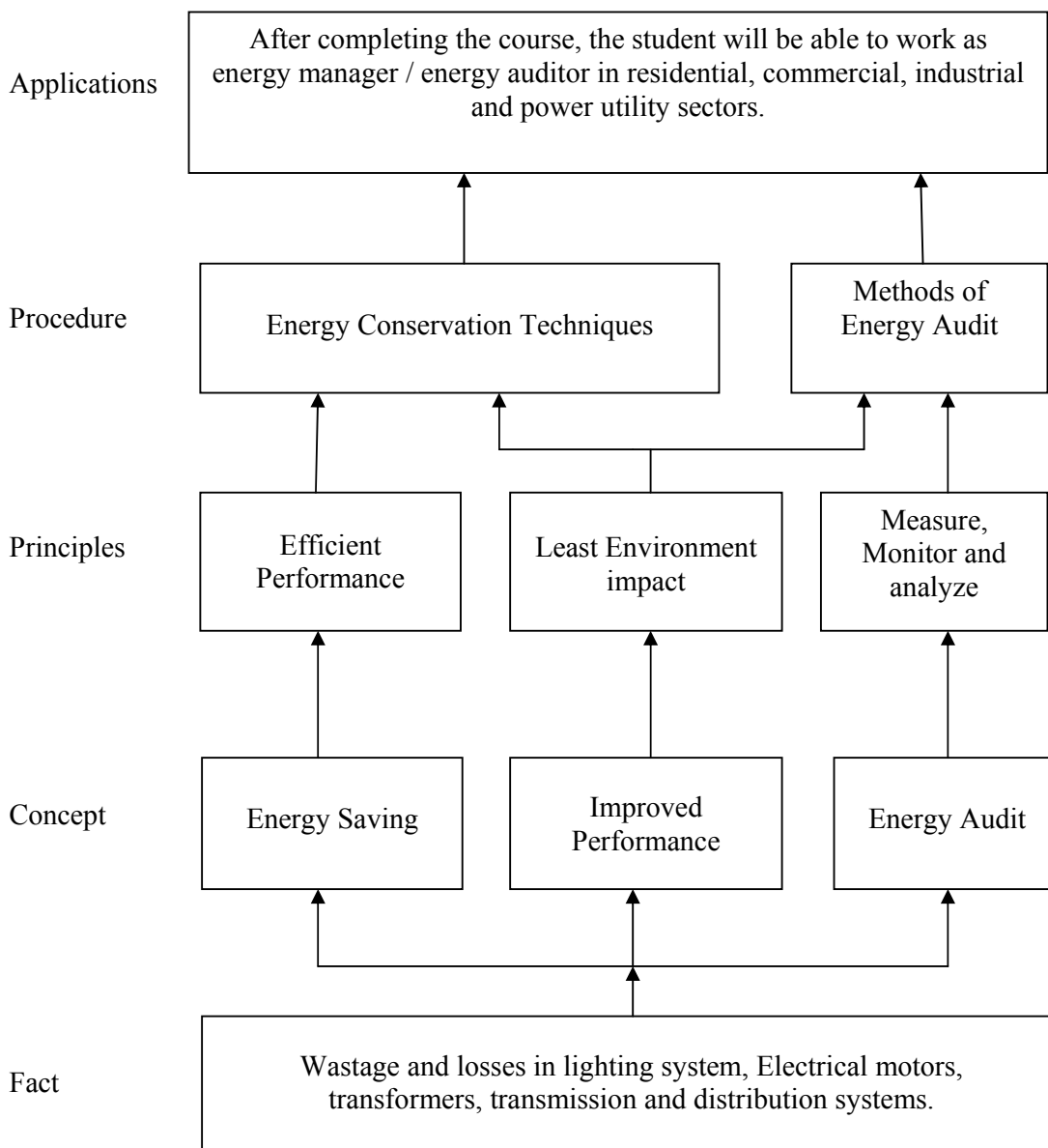
The contents on energy conservation techniques in lighting systems, motors, transformers and transmission - distribution lines will be useful to reduce energy losses and wastage in residential, commercial and industrial sectors.

The topic on energy audit will be an useful tool to participate in energy conservation program of the nation.

General Objectives:

The students will be able to:

1. Identify the energy losses and wastage.
2. Suggest the energy conservation techniques in various sectors.
3. Find the opportunity for saving in energy consumption through tariff structure.
4. Prepare energy audit report.

Learning Structure:

Theory:

Topic and Contents	Hours	Marks
Topic 1 : Energy Conservation Specific Objectives: <ul style="list-style-type: none"> ➤ Identify the need of Energy Conservation. ➤ State functions of Government organization working for ECA. Contents: <ol style="list-style-type: none"> 1.1 Preset energy scenario. 1.2 Need of energy conservation. 1.3 State the meaning of term Energy Conservation. 1.4 Energy Conservation Act – 2003. 1.5 Functions of Government Organization (NPC, MNRE, BEE, MEDA). 	02	04
Topics 2: Energy Conservation in Lighting System Specific Objectives: <ul style="list-style-type: none"> ➤ Assess existing lighting system ➤ Identify energy conservation techniques in lighting system. ➤ Suggest methods to improve energy conservation Contents: <ol style="list-style-type: none"> 2.1 Basic terms used in Lighting system (Illumination). 2.2 Recommended Luminance levels 2.3 Procedure for assessing existing Lighting system in a facility. 2.4 Energy Conservation techniques in lighting system. <ul style="list-style-type: none"> • By replacing Lamp sources. • Using energy efficient luminaries. • Using light controlled gears. • By installation of separate transformer / servo stabilizer for lighting. • Periodic survey and adequate maintenance programs. • Energy Conservation techniques in fans, Electronic regulators. 	06	12
Topic 3 : Energy Conservation techniques in Electrical Motors Specific Objectives: <ul style="list-style-type: none"> ➤ Select electrical motors for suitable application. ➤ Energy conservation techniques for improving the performance of motor by various methods. Contents: <ol style="list-style-type: none"> 3.1 Construction, Power flow and working of Induction motor. 3.2 Factors governing the selection of Induction motor. 3.3 Need for energy conservation in Induction motor. 3.4 Various energy conservation techniques in Induction motor. <ul style="list-style-type: none"> • By improving Power quality. • By motor survey. 	06	14

<ul style="list-style-type: none"> • By matching motor. • By minimizing the idle and <ul style="list-style-type: none"> ○ Redundant running of motor. • By operating in star mode. • By rewinding of motor. • By improving mechanical <ul style="list-style-type: none"> ○ power and transmission ○ Efficiency. <p>3.5 Energy Efficient motors.</p> <ul style="list-style-type: none"> • Comparison with conventional Induction motor 		
<p>Topic 4: Energy Conservation techniques in transformer</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ List out the methods to improve performance of transformer. ➤ Suggest energy conservation techniques to improve transformer performance <p>Contents:</p> <p>4.1 Need of energy conservation in transformer.</p> <p>4.2 Methods (related to material, design) to improve the performance of transformer.</p> <p>4.3 Energy conservation techniques related to transformer.</p> <ul style="list-style-type: none"> • Loading sharing • Parallel operation • Isolating techniques <p>4.4 Energy efficient transformers.</p> <ul style="list-style-type: none"> • Amorphous transformers • Epoxy Resin cast transformer (Dry type of transformer). • Periodic maintenance. 	04	08
<p>Topic 5 : Energy conservation in transmission and distribution system.</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State scenario of losses in transmission and distribution system ➤ Identify Energy conservation opportunities ➤ Suggest methods for energy conservation. <p>Contents:</p> <p>5.1 Scenario of transmission and distribution losses at state level, national level and at global level.</p> <p>5.2 Types of losses in transmission and distribution system (commercial and technical losses)</p> <p>5.3 Energy conservation techniques in transmission and distribution system related to technical losses.</p> <ul style="list-style-type: none"> • By reducing I^2R losses. • By compensating reactive power flow. • By optimizing distribution <ul style="list-style-type: none"> ○ voltage • By balancing phase currents. • By using energy efficient <ul style="list-style-type: none"> ○ Transformers <p>5.4 Energy conservation techniques related to commercial losses.</p>	06	12

<p>Topic 6: Relation Between Tariff And Energy Conservation.Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify the opportunities to reduce energy bill through selection of tariff structure ➤ Select appropriate tariff structure to reduce energy bill <p>Contents:</p> <p>6.1 Types of tariff structure.</p> <p>6.2 Terms involved in tariff.</p> <p>6.3 Specific tariff:</p> <ul style="list-style-type: none"> • Time-off-day tariff • Peak-off-day tariff • Power factor tariff • Maximum Demand tariff • Load factor tariff <p>6.4 Application of tariff system to reduce energy bill.</p> <p>6.5 Simple numerical based on power factor and load factor tariff.</p>	06	14
<p>Topic 7 : Energy Conservation by Cogeneration</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Classify cogeneration systems. ➤ Selection of appropriate cogeneration system to reduce energy bill <p>Contents:</p> <p>7.1 What is cogeneration?</p> <p>7.2 Need for cogeneration.</p> <p>7.3 Classification of cogeneration system on the basis of sequence of energy use.</p> <ul style="list-style-type: none"> • Topping cycle • Bottoming cycle <p>7.4 Classification of cogeneration system on the basis of technology.</p> <ul style="list-style-type: none"> • Steam turbine cogeneration. • Gas turbine cogeneration • Reciprocating engine cogeneration. <p>7.5 Factors governing the selection of cogeneration system.</p> <p>7.6 Advantages of cogeneration.</p>	04	12
<p>Topic 8 : Energy Conservation Equipment</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ List out energy conservation equipments. ➤ Select proper energy conservation equipments in various applications. <p>Contents:</p> <p>8.1 What is energy conservation equipment?</p> <p>8.2 Energy conservation equipment related to Lighting system.</p> <ul style="list-style-type: none"> • Centralized Control Equipment (Microprocessor based). • Occupancy sensors/Motion Detectors. • Control gears: Dimmers, Regulators, and Stabilizers). <p>8.3 Energy conservation equipment related to electrical motors: Construction, working and advantages of each energy conservation</p>	06	12

<p>Equipment listed below:</p> <ul style="list-style-type: none"> • Soft starter: For induction motors • Power Factor Controller • Static capacitor • Automatic star delta starter • Variable Frequency Drives. <p>8.4 Energy conservation equipments in T&D system: Working principle and operation of</p> <ul style="list-style-type: none"> • Maximum Demand Controller • KVAR Controller • Automatic Power Factor controller. 		
<p>Topic 9 : Energy Audit</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ Select energy audit instruments. ➤ Prepare/Develop questionnaire for energy audit. ➤ Apply ABC analysis in energy projects. ➤ Calculation of simple pay back period. ➤ Write energy audit report. <p>Contents:</p> <p>9.1 Energy flow diagrams and its significance.</p> <p>9.2 Energy audit instruments and their use.</p> <p>9.3 Prepare questionnaire for energy audit projects.</p> <p>9.4 ABC analysis and it's advantages referred to energy audit projects.</p> <p>9.5 Energy Audit procedure (walk through audit and detailed audit).</p> <p>9.6 Calculation of simple pay back period (Simple numerical)</p>	08	12
Total	48	100

List of Assignments:

1. Collect the information about energy conservation act from IEE 2003.
2. Prepare a write up on role of Energy Manager and Energy Auditor.
3. Collect of information by market survey and prepare report on rating, luminous output, cost, list of manufacturers of various types of energy efficient luminaries (FTL, CFL, LED, Sodium Vapour, HPMV etc.)
4. Make a comparative study of energy efficient control gears and ballasts used in lighting system on the basis of energy efficiency, cost, life, energy saving and saving in energy bill
5. Visit to any organization where energy conservation program is implemented (Hospitals, workshops, institutes, commercial building, residential building etc.)
6. Using various energy audit instruments used for measurement of electrical, mechanical and thermal energy parameters, carryout energy audit and prepare a report as a case study for Residence, Small workshop, Public Library, Hospital etc.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1	S. Sivanagraju M. Balasubba Reddy D. Srilatha	Generation And Utilization Of Electrical Energy	Pearson, New Delhi

2	P. H. Henderson	India - The Energy Sector	University Press
3	W. C. Turner	Energy Management Handbook	Wiley Press
4	B. G. Desai J. S. Rana A. V. Dinesh R. Paraman	Efficient Use And Management Of Electricity In Industry	Devki Energy Consultancy PVT. Ltd.

2. Websites:

1. Website of bureau of energy and efficiency : www.bee-india.nic.in
2. Website of Akshay Urja News Bulletin : www.mnes.nic.in
3. Notes on energy management on : www.energymanagertraining.com
4. www.greenbusiness.com
5. www.worldenergy.org

Course Name : Electrical Engineering Group**Course Code : EE/EP****Semester : Fifth****Subject Title : Industry Electrical Systems-II****Subject Code : 17507****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
04	--	--	03	100	--	--	--	100

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).

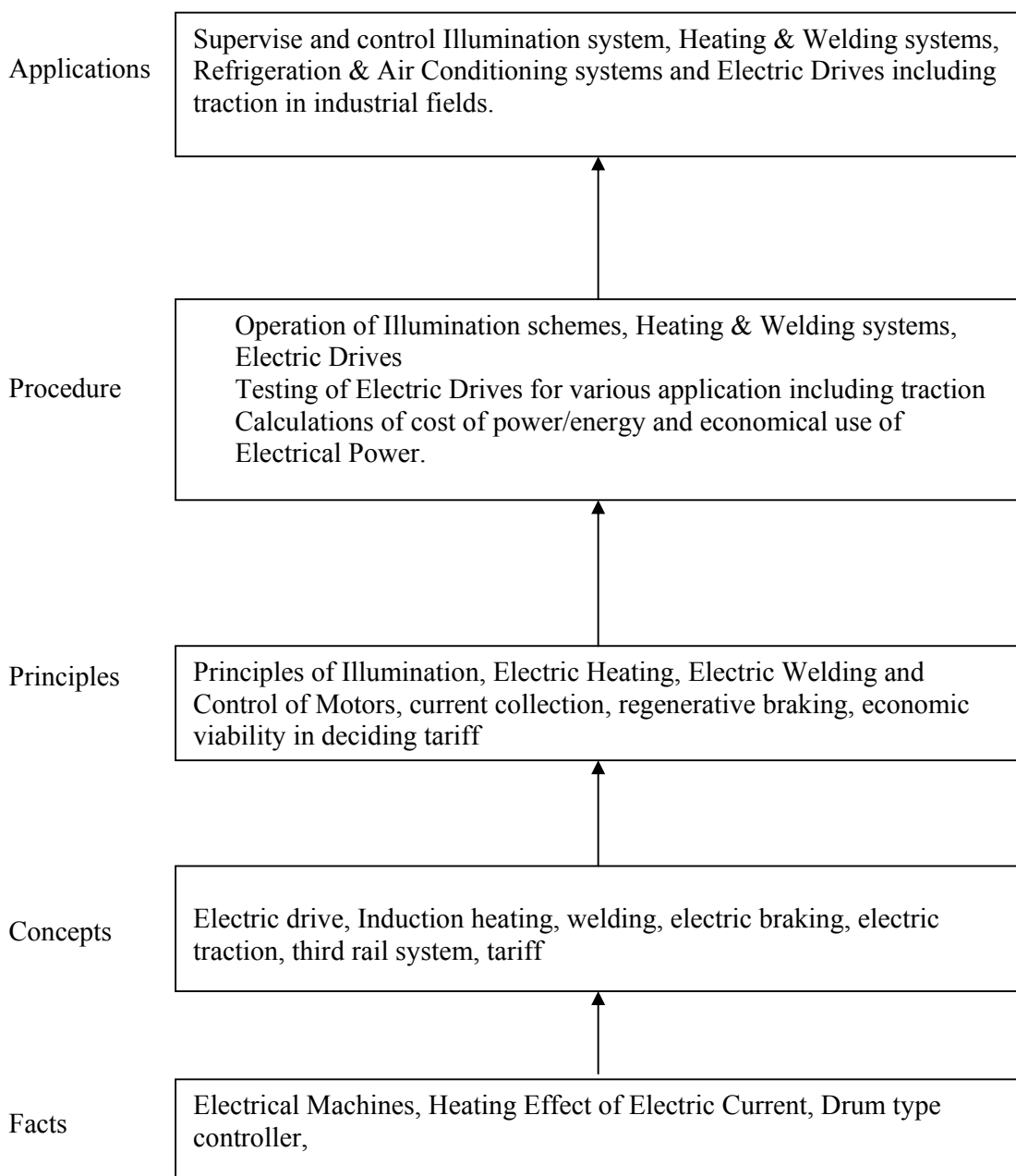
Rationale:

The main Job functions of a electrical diploma holder are to supervise the operation & control of various electrical drives, electrical furnaces, electrical welding equipments. The factory illumination scheme is also to be maintained by them. Therefore the knowledge of operation & control of these machines & equipments is required for every diploma engineer, Railway is the one of major employer of electrical diploma engineer; therefore it is essential for a diploma holder to acquire the knowledge of electric traction.

Due to power crises, economical utilization of electrical energy and energy conservation is an essential aspect. Hence it is essential for every diploma engineer to study the utilization of electrical energy.

General Objectives:

1. Select drive for specific application.
2. Compare different methods of electric heating & welding.
3. Explain the importance of good illumination
4. Explain the various components in electric traction system.
5. Get the knowledge of electrical energy conservation.

Learning Structure:

Theory:

Topic and Contents	Hours	Marks
Topic 1: Electric Drives & Elevators Specific Objectives: ➤ Selection of particular drive for a particular application Contents: <ul style="list-style-type: none"> • Concept of drive and its Advantages & Disadvantages • Factors Governing Selection of Electric Drives (Motor) • Nature of Drives :- Group, Individual & Multi motor Drives, their Advantages, Disadvantages and Applications • Mechanical Features of drives: <ul style="list-style-type: none"> ➤ Purpose, Types & Application of various types of Enclosure, ➤ Function of Bearing, Types of Bearing (Ball & Sleeve Bearing) Advantages & Disadvantages, Applications, • Transmission of Mechanical Power: • Direct drive and its applications • Indirect Drives: Belt, Rope, Chain, Gear & Vertical drives and their Applications, • Noise : Reasons for production of noise & Methods of Noise reduction • Size & Rating of Motor : Definition of Standard Rating as per ISS -- ---- a) Continuous Rating b) Continuous maximum Rating c) Short time Rating, • Load Cycles : Continuous loading, Short time loading, Long time (Intermittent) Loading, Continuous operations short time loading, Continuous operations long time loading: Concept with graphical representation • Expression of Rating of motor [No Derivation] Simple Numerical on estimating Size (Rating) of Continuously Rated Motor. • Load Equalization : Meaning of load equalization, Method of load equalization, Condition of load equalization • Braking : Definition of Braking, Requirements of Ideal Braking System, Advantages & Disadvantages of Electrical Braking over Mechanical Braking System. <ul style="list-style-type: none"> ▪ Types of electrical braking systems: plugging, Rheostatic (Dynamic) & Regenerative braking for D.C Series Motor, 3 - Phase Induction Motor, ▪ Condition to achieve Regenerative Braking. • Elevators: Function, Application of Elevator, Ideal Requirements of Elevators, Meaning of Car & Pent house, Factors on which Shape & Size of Car depends, unit of Speed of Elevators, Factors affecting Speed of Elevators. 	10	20
Topics 2: Electric Heating Specific Objectives: ➤ Select method of Electric Heating as per requirement of the application ➤ Decide the rating of the equipment Contents: <ul style="list-style-type: none"> • Concept of electrical heating, Classification of Electric Heating Advantages & disadvantages, Modes of Heat transfer with 	10	16

<p>definitions,</p> <ul style="list-style-type: none"> Resistance Heating:- Properties of material used as a heating element, Causes of failure of heating element, Design of heating element (Circular & Rectangular Strip), Simple Numericals, Methods of temperature control (By varying voltage across heating element, By varying the value of Resistance of Heating element, By use of Thermostat), Direct & Indirect resistance heating: Meaning of the terms, Working principle, constructional features and applications Arc Heating: - Principle of Arc Heating, Properties of material used for electrode, advantages of graphite electrode over carbon electrode,. Direct Arc Furnace: - Constructional features and operation of arc Furnace, Specifications of arc furnace: Temperature obtain, Power Factor, Size (capacity) of furnace, Average Power required, Average Energy consumption required, and Its Applications. Indirect Arc Furnace :- Constructional features and operation, Specifications: Temperature obtain, Power Factor, Average Power required, Average Energy consumption, Its Applications, Advantages & Disadvantages Temperature Control : Voltage Control method & Electrode-positioning control with figure List of Equipments used in arc furnace & their application. Induction Heating :- Working Principle, Constructional features, Principle of operation, Advantages & Disadvantages & Applications of Direct Induction Core type furnace: Horizontal & Vertical (Ajax Wyatt)], Indirect Induction Furnace [No Numericals] Eddy Current Heating: - Principle, Nature of Supply used, Advantages, Disadvantages & Applications. Dielectric Heating: - Principle, Nature of supply used, Advantages, Disadvantages & Applications. [No derivation & Numericals] 		
<p>Topics 3: Electric Welding</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Compare Methods of Electric Welding ➤ Select type of welding for various applications/jobs <p>Contents:</p> <ul style="list-style-type: none"> Meaning of the term Welding, Requirements of good welding, Advantages of electric welding, Classifications of welding system, meaning of term plastic & Fusion welding. Factors Considered while selecting welding System for a particular job, ways and means of avoiding weld defects. Resistance Welding: types of Resistance welding, principle and operation, applications of each type, advantages & disadvantages, Safety Equipments Arc Welding: Principle and operation of Metal & Carbon Arc welding, Characteristics of arc, Factors on which arc length depends, methods of stabilization of arc. Types of Electrodes, advantages of coated electrode. Supply requirements, D. C. Straight Polarity and D. C. Reverse Polarity. Use of DCSP for Carbon arc welding. Advantages and Disadvantages and applications. 	08	14

<p>Topics 4: Illumination Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand the terms used in illumination System ➤ Describe various lighting schemes with their features <p>Contents:</p> <ul style="list-style-type: none"> • Definition of Light , Luminous flux, Intensity, Lumen, Candle Power, Illumination, Lux or meter Candle, MHCP, MSCP, MHSCP, Reduction factor, lamp efficiency, Specific Consumption, Glare, Space-Height ratio, Utilization Factor, Maintenance Factor , Depreciation Factor, Waste light Factor, Absorption Factor & Reflection Factor, Solid Angle. • Working principle, Construction, Operation and applications of: Fluorescent Tube, CFL, Mercury Vapour, Sodium Vapour and Metal Halide lamps • Types of Lighting Schemes: - direct, Semi-Direct, Indirect & semi-Indirect lighting Schemes with Applications. 	06	08
<p>Topics 5: Electric Traction : Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Select Electric Supply Systems for Electric Traction ➤ Decide track electrification system as per requirements <p>Contents:</p> <ul style="list-style-type: none"> • Requirements of an Ideal Traction System. • Different types of Traction System used in India, Advantages & Disadvantages of Electric Traction System. Comparison between various Traction systems. • Systems of Track Electrification: D.C Track Electrification, Single phase 25 KV AC Supply System, Composite System: 1-Phase AC-DC Supply System. Advantages, Disadvantages and Application of above track Electrification System. Comparison between 1-phase 25 KV AC and D.C Track Electrification. • Traction Motors: Desirable Characteristics of an Ideal Traction Motor. • Various types of Traction Motors: Main Features and applications, Advantages and Disadvantages of D.C Series Motor and 1-Phase A.C Series Motor • Traction Motor Control: Steps involved in Series-Parallel Control with Rheostat and their Advantages and Disadvantages • Meaning of the term Transition, Purpose of transition, Steps involved in Shunt Transition & Bridge Transition with advantages and Disadvantages • Traction Mechanics :- Block Diagram of A.C Electric locomotive and function of each part, Classification of Traction Services: Urban, Suburban & Main line Services and their comparison • Speed time Curve: Trapezoidal and Quadrilateral Speed Time curve. Applications. • Definition of average and schedule Speed, Factors affecting Schedule Speed. (Simple Numerical). 	16	24

Topics 6: Tariff : Specific Objectives: ➤ Identify type of consumer based on the demand ➤ Decide the Tariff for a consumer Contents: <ul style="list-style-type: none"> • Meaning of the term Tariff, Desirable Characteristics of Tariff System. • Types of Tariff :- Block Rate Tariff, KVA Maximum Demand Tariff (Two part Tariff) & TOD (Time Of Day Tariff), Simple Numericals 	04	06
Topics 7 : Power Factor Improvement : Specific Objectives: Decide the economical size of the P.F. improvement device for minimum cost of energy ➤ Select method of P. F. improvement as per the requirements of consumer Contents: <ul style="list-style-type: none"> • Power Triangle, Disadvantage of low Power factor, Advantages of improved Power Factor. • Causes of Low Power Factor, Avoidance of Low power factor without using P.F. improving apparatus. • P.F. improvement using Static Capacitor: Vector Diagram & Power Triangle, Advantages & Disadvantages and Simple Numericals. • Most Economical Power factor: Derivation & Simple Numericals. • Location of P.F. improving apparatus from Consumer & Electrical Supply Company point of view. 	10	12
Total	64	100

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1.	H.Partab	Art & Science of Utilization of Electrical Energy	Dhanpat Rai & Sons
2.	J.B.Gupta	Utilization of Electric Power & Electric Traction	S.K.Kataria & Sons
3.	V.K.Mehta & Rohit Mehta	Principals of Power System	S.Chand
4.	H.Partab	Modern Electric Traction	Dhanpat Rai & Sons
5.	S.Sivanagaraju M.Balasubba Reedy B.Srilatha	Generation & Utilization of Electrical Energy	Pearson

2. IS, BIS and International Codes:

1. IS 1860-1980 code of Practice for Installation, Operation and Maintenance of Electric Passenger and Goods Lifts.
2. IS 3534-1976 Outline Dimensions of Electric Lifts.

3. Websites:

1. sonaversity_org
2. www.animations.physics.unsw.edu.au
3. www.khanacademy.com

Visits:-

1. Visit to Sugar Industry.
2. Visit to Steel Manufacturing Industry/ Foundry.
3. Visit to welding Workshop.
4. Visit to Locomotive Shed.

These Visits may be arranged under the Subject of Professional Practices.

Course Name : Electrical Engineering Group**Course Code : EE / EP****Semester : Fifth****Subject Title : Switchgear and Protection****Subject Code : 17508****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:

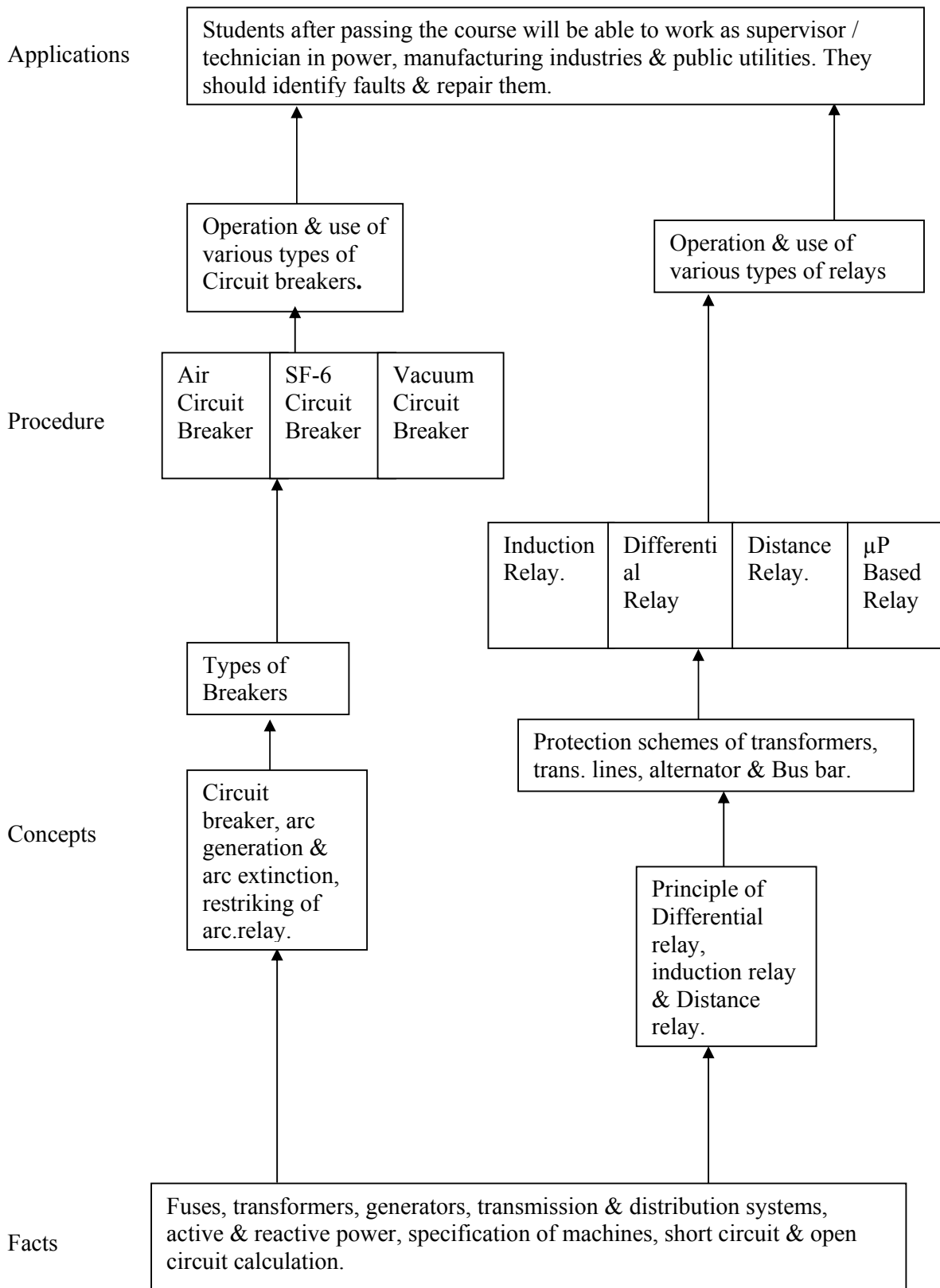
In spite of all care and precautions taken in the design, installation and operation of Power system and power equipments, abnormal conditions and faults do occur in the system. Some fault such as short circuits can prove highly damaging, not only to the components but also to the entire power system. However continuity of power supply is the need of the hour.

So study of switchgear and protection is needed. It is expected that the knowledge of facts, concepts, principles and procedural aspects of switchgear and protection system must be known by students which ultimately help them to maintain the reliability of electric supply in discharging their duties as a supervisor or a technician in substation, manufacturing industries and public service utilities.

General Objectives:

The students will be able to

1. Understand the principles, concepts & procedural aspects of switchgear & protection.
2. Identify various components of switchgear & protection system & their locations.
3. Know the specification and to select a switchgear for a particular application.
4. Identify various faults in power system & measures to minimize it.
5. Know the basic concepts of protection scheme and to select appropriate protection scheme for a particular application.
6. Know the need of insulation co-ordination.

Learning Structure:

Theory:

Topic and Contents	Hours	Marks
Topic 1: Fundamental Specific Objectives: <ul style="list-style-type: none"> ➤ State the need and function of protection system ➤ Differentiate the normal & abnormal conditions of power system ➤ List the types of fault & their causes ➤ Calculate short circuit current , short circuit kVA Contents: <ul style="list-style-type: none"> • Switchgear equipments - Symbols and functions • Functions of protective system. • Normal & abnormal conditions. • Types of faults & their causes. • Short circuit calculations(Symmetrical faults only) • Use of current limiting reactors & their arrangements. 	04	10
Topic 2: Circuit Interrupting Devices Specific Objectives: <ul style="list-style-type: none"> ➤ List various methods of arc extinction ➤ Select circuit breaker as per application Contents: <ul style="list-style-type: none"> • Construction, characteristics of HRC Fuse • Isolators- Vertical break, Horizontal break & Pantograph type • Arc formation process, methods of arc extinction - High resistance method, Low resistance or current zero method • Definition: Arc voltage, Recovery voltage, Restriking voltage, RRRV ➤ Circuit breakers- Concept, Classification, Working principle, Construction, Specification & Applications of: • L.T.- Air circuit breakers (ACB), Miniature circuit breakers (M C B), Moulded case circuit breaker (M C C B), Earth leakage circuit breaker (ELCB), (More focus on LT C.B) • H.T – Air Blast Circuit Breaker, Sulphur Hexa Fluoride circuit breaker (SF₆), Vacuum circuit breaker. • Comparison of fuse & MCCB • Selection of MCCB for motor. • Selection and rating of circuit breakers 	08	16
Topic 3 : Protective Relaying Specific Objectives: <ul style="list-style-type: none"> ➤ List the essential qualities of protective relaying ➤ Classify various types relays ➤ Selection of protective relays as per the system requirement Contents: <ul style="list-style-type: none"> • Quality requirements of relay system: selectivity, speed, sensitivity, reliability, simplicity, Economy: meaning of the term and its significance in protective relaying • Basic Relay Terminology - Protective relay, relay time, pick up current, reset current, current setting, plug setting multiplier (PSM) ,Time setting multiplier (TMS) • Numericals on PSM &TMS • Classification Electromagnetic relay – 	09	20

<ul style="list-style-type: none"> • Operation of Attracted armature type, Solenoid type and Balanced beam type relays. • Electro magnetic induction type - Operation of Shaded pole type and Watt hour meter type relays. • Block diagram, Operation, Advantages & disadvantages of Static and μP based relays. • CT and PT as Protective transformers. -Safety precautions while using C.T. and P.T. , Circuit Diagram with Relay • Over current relay-Time current characteristics. • Operation of Static over current relay with block diagram • Operation of μP based over current relay with block diagram • Distance relaying- Principle, Operation of – Definite distance relay, Time distance relay and MHO relay • Directional relay- The need of directional relay, construction, operation of Induction type directional over current relay • Differential Relay- Operation of Current differential relay & Voltage differential relay. 		
<p>Topic 4 : Protection of Alternator</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State various faults and Abnormalities of alternator ➤ Sketch various protection schemes of alternator ➤ State the concept of reverse power protection ➤ Calculate the % protection provided <p>Contents:</p> <ul style="list-style-type: none"> • Abnormalities & Faults • Circuit diagram with proper current direction of Differential protection, Over current, earth fault, inter -turn fault, negative phase sequence, over heating protection. • Reverse power protections. (Simple numerical on differential protection) 	06	12
<p>Topic 5 : Protection of transformer</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Identify various faults & abnormalities of transformer ➤ State and draw various protection scheme of transformer ➤ Importance of Buchholz Relay ➤ Contents :- • Abnormalities & faults. • Differential, Biased differential protection • Limitations of differential protection of transformer, • Over current, Earth fault, Inter turn, Restricted earth fault, Over heating protection. • Buchholz relay (Simple numerical on differential protection) 	08	14
<p>Topic 6 : Protection of Motor</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ State various faults & abnormalities of motor ➤ Observe the behavior of single phasing preventer ➤ Identify various protection provided for motors <p>Contents:</p> <ul style="list-style-type: none"> • Abnormalities & faults. • Short circuit protection, Overload protection, Single phase preventer- (circuit diagram, operation) 	03	06

Topic 7 : Protection of Busbar & Transmission line Specific Objectives: <ul style="list-style-type: none"> ➤ Identify the faults & abnormalities of Transmission lines ➤ State the principle of over current protection, distance protection Contents : <ul style="list-style-type: none"> • Abnormalities & faults. • Bus Bar Protection – Operation of Differential Protection and Fault bus protection schemes. • Transmission line, over current, distance protection. Pilot wire protection. 	04	10
Topic 8 : Neutral Earthing Specific Objectives: <ul style="list-style-type: none"> ➤ State the need of Neutral earthing ➤ Distinguish between equipment earthing and neutral earthing ➤ List types of neutral earthing Contents:- <ul style="list-style-type: none"> • Introduction & importance. • Types of earthing: diagram, procedure • Substation earthing: diagram, procedure • Difference between Equipment earthing and Neutral earthing 	02	04
Topic 9 : Over Voltage Protection Specific Objectives: <ul style="list-style-type: none"> ➤ State the causes of over voltage ➤ List types of lightning arrester ➤ State the necessity of insulation co-ordination ➤ Identify basic components of lightning arrester Contents : <ul style="list-style-type: none"> • Causes of over voltages. • Lightning phenomena, over voltage due to lightning, typical waveform of lightning surge • Protection of transmission line & substation from direct stroke. • Types of lightning arresters - Rod gap, Horn gap, Expulsion and Thyrite type, their construction & principle of operation. • Surge absorber - Definition & working with neat diagram. • Protection against traveling waves. • Necessity of Insulation co-ordination, 	04	08
Total	48	100

Practical:**Skills to be developed:****Intellectual Skills:**

7. Identify different types of circuit breakers
8. Identify various faults on the system
9. Calculate the fault levels

Motor Skills:

2. Simulate circuit configuration to create various faults
3. Set the relays for various fault levels

List of Practicals:

1. To study different switchgear equipments used in Electrical power system and also to collect technical specification of various switchgear equipments through market survey.
2. To demonstrate the operation of MCB/MCCB
3. To perform Current (I) Vs Time (T) characteristics of fuse (Kit kat / HRC)
4. To set and test any one electromagnetic relay with C.T & P.T
5. To plot the characteristic of over current thermal /induction relay
6. To demonstrate the operation of single phasing preventer for protection of 3 phase induction motor
7. To visit a high voltage substation to study & observe the protection scheme of Transformer/ Busbar
8. To demonstrate operation of Buchholz relay
9. To understand the types & specification of lightning arresters through brochures /literature.
10. Simulation of protection scheme of 1 - 5 kVA 3 phase transformer.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1	S.Rao.	Switch Gear & Protection	Khanna Publications, New
2	Badriram & Vishwakarma P.N.	Power System Protection & Switchgear	TMH, New Delhi
3	V. K. Mehta	Principles of Power System	S. Chand & Co.
4	Bhavesbhalja, R.P. Maheshwari & N.G. Chothani	Protection & Switchgear	Oxford
5	R.P.Singh	Switchgear and Power System Protection	PHI
6	Mason C.R.	The art & science of protective relaying	-----

Course Name : Diploma in Electrical Power System**Course Code : EP****Semester : Fifth****Subject Title : Power System Analysis****Subject Code : 17510****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	02	03	100	--	--	50@	150

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 System Engineer with thorough knowledge in power system for its operation and control is needed in Power utilities -This requires study of analysis of its performance under various working conditions. This subject deals with the representation of the power system, analysis of its components and determine performance by analytical as well as graphical methods which will be useful in analysis of electrical power system. This subject provides the basic knowledge required to study power system operation & control, Power Quality & deregulation System.

The topic representation of power system will be useful to know the actual components of power system, Circuit model of system along with their per unit values. The topic Transmission line parameter is useful to study the effects of parameter on performance of power system.

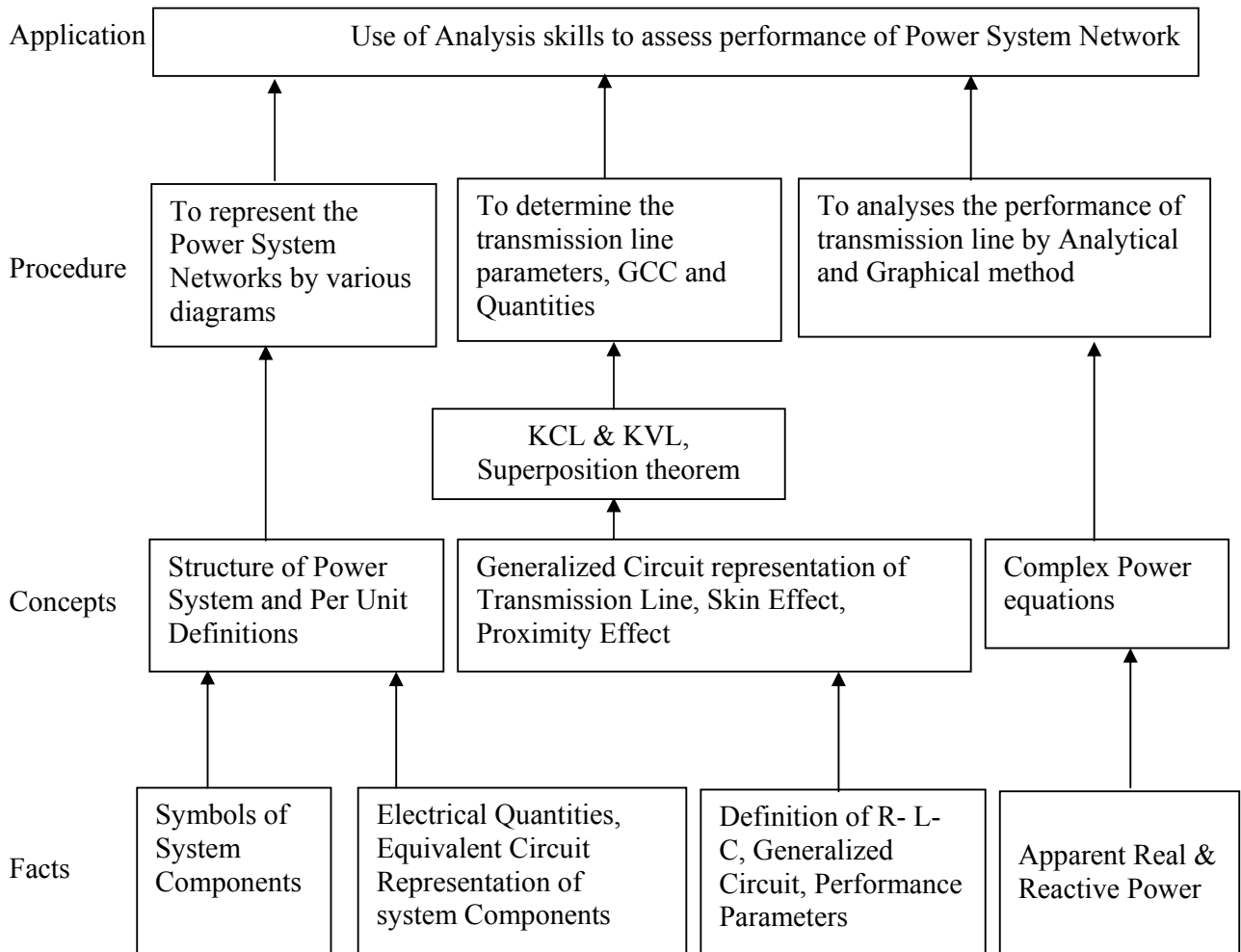
Generalized circuit constants method is very useful & simple tool for predicting the performance of power system wrt. its parameters. Power flow serves as guidance for analysis of power system analytically & Circle diagram is a graphical tool for putting across the concept of load flow & line compensation,

MATLAB is a powerful software package used for high performance scientific numerical computation. The combination of analysis capabilities, flexibility, Reliability & powerful graphics makes MATLAB the main software package for Power System Engineer.

General Objectives:

Students will be able to

1. Identify Power System Components
2. Draw the different diagrams of given Power System.
3. Represent power system in per unit system.
4. Compute line parameters of transmission line.
5. Simulate short, Medium & long transmission line.
6. Determine the complex power of power system.
7. Analyze the system performance analytically & graphically.

Learning Structures:

Theory:

Topic and Contents	Hours	Marks
Topic 1: Representation of Power System Specific Objectives: <ul style="list-style-type: none"> ➤ Identify power system components. ➤ Develop per unit reactance diagram for given system ➤ Understand the role of power system engineer Contents: <ul style="list-style-type: none"> • Basic Structure of Power System. • Equivalent Circuit representation of the System components-Alternator, Transformer, Transmission line: Short, Medium & long • Single line diagram. • Impedance diagram. • Reactance diagram. • Per unit Calculations. .(Numerical) • Aspects of Power System analysis. • Role of power system Engineer 	06	12
Topic 2: Transmission Line Parameter Specific Objectives: <ul style="list-style-type: none"> ➤ Understand significance of transmission line parameters ➤ Compute Transmission line parameters ➤ Study the effect of Earth on transmission line parameters Contents: <p>2-1 Resistance</p> <ul style="list-style-type: none"> • Concept of transmission line resistance. • Difference between A.C. resistance & D.C. resistance. • Influence of skin effect and proximity effect on Line conductors. • Effect of temperature on Transmission line resistance.(No derivation) • Effect of resistance on line performance. <p>2.2 Inductance</p> <ul style="list-style-type: none"> • Concept of Transmission Line Inductance. • Significance of inductance. • Flux linkage of isolated current carrying conductor due to internal and external flux. (Derivation only) • Inductance of single-phase line composed of solid conductors & bundled conductors. (No Numerical) • Concept of self G.M.D. and mutual G.M.D. (Numerical) • Inductance of single phase line composed of composite conductors. (No derivation) Numerical • Inductance of three phase line (single circuit) composed of solid conductors with symmetrical and asymmetrical spacing. <p>2.3 Capacitance</p> <ul style="list-style-type: none"> • Concept of Line capacitance. • Significance of capacitance. 	02	08
	08	16
	06	10

<ul style="list-style-type: none"> • Potential difference between two points due to charged conductors (Gauss's Law.) • Potential difference between two conductors in a group of charged conductors. • Capacitance of single phase line composed of solid Conductors and duplex bundled conductors. (Numerical) • Capacitance of three phase line (single circuit) with symmetrical spacing. (Numerical) • Effect of earth field on transmission line capacitance. • Capacitance of single phase line with solid conductors considering earth 		
<p>Topic 3: Generalized Circuit</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand Generalized circuit constant equations ➤ Compute Generalized circuit constants of Transmission line which is being designed ➤ Measure Generalized circuit constants of Transmission line which is already built by performing few ordinary tests ➤ Determine performance of line by using Generalized circuit constant equations <p>Contents:</p> <p>3.1</p> <ul style="list-style-type: none"> • Concept of generalized circuit constants. • Generalized circuit constants of short, medium & long transmission line. (No derivation) Numerical • Measurement of Generalized circuit constant <p>3.2</p> <ul style="list-style-type: none"> • Generalized circuit constants of two networks connected in series & connected in parallel. (Only derivation) • Advantages of Generalized circuit representation. 	10	16
<p>Topic 4: Power Flow</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> ➤ Understand the concept complex power ➤ Compute real power & reactive power for sending end & receiving end by using complex power equations. ➤ Design the parameters of line for getting maximum sending end & receiving end power. <p>Contents:</p> <ul style="list-style-type: none"> • Concept of Complex Power ($S=V I^*$), Real Power and reactive Power. • Derivation of complex power, real power, reactive power for sending end as well as receiving end of the tr.line using GCE(Numerical) • Condition for maximum power (Numerical) 	06	12
<p>Topic 5: Circle Diagram</p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> • Understand the concept of circle diagram of transmission line 	08	18

<ul style="list-style-type: none"> • Determine the performance of line by drawing circle Diagram. • Design the rating of compensation equipment as per requirement. <p>Contents:</p> <ul style="list-style-type: none"> • Concept of circle diagram. • Receiving end circle diagram.(procedure and numerical) • Determination of ratings of reactive power compensating equipments. (procedure and numerical) • Sending end circle diagram. (procedure and numerical) • Advantages of circle diagram. 		
Total	48	100

Practical:**Skills to be developed:****Intellectual Skills:**

1. Identify power system parameters.
2. Understand single line Diagram.
3. Know the concept of Circle Diagram.

Motor Skills:

1. Draw The single line diagram.
2. Measure values of line parameters.
3. Perform simulation for power system network.

List of Practicals:

1. Collect information of structure of power system in Maharashtra Grid & write report of it with details of Generation voltage levels. Transmission & distribution voltage levels. Transformer rating & connections.
2. Determine Self & Mutual GMD for various conductor configuration (min 8 example)
3. Measure generalized circuit constants for Nominal T model.
4. Measure generalized circuit constants for Nominal Π model.
5. Calculation of per unit values by using MATLAB programme.
6. Determination of GCC of Medium Transmission line by using MATLAB programme.
7. Calculate Receiving end complex power by using MATLAB programme.
8. Calculate Sending end complex power by using MATLAB programme.
9. Draw sending end Circle Diagram by using MATLAB programme.
10. Draw Receiving end Circle Diagram by using MATLAB programme.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1	B.R. Gupta	Power system Analysis and Design	Wheeler Publication
2	I. J. Nagrath & D. P. Kothari	Modern Power system Analysis	Tata McGraw Hill Publication(Fourth Edition 2011)
3	T. K. Nagsarkar & M. S. Sukhija	Power system Analysis	OXFORD university Press
4	John J. Graninger & William D. Stevenson J. R.	Power system Analysis	Tata McGraw Hill Publication
5	C. L. Wadhwa	Electrical power systems	New Age International Publishers (Sixth Edition)

2. Websites:www.mahatransco.comwww.mhdcl.com

Course Name : Electrical Engineering Group**Course Code : EE /EP****Semester : Fifth****Subject Title : A. C. Machines****Subject Code : 17511****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
03	--	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:

A.C. Machines is a core technology subject consisting constructional details, working principles, operation and characteristics of various three phase and single phase machines such as Three phase Induction motors, Three phase AC generators, three phase synchronous motor and single phase Induction motors.

AC motors are widely used in various industries such as paper industry, chemical industry, machine tools, sugar industry, agricultural applications, railway traction etc.

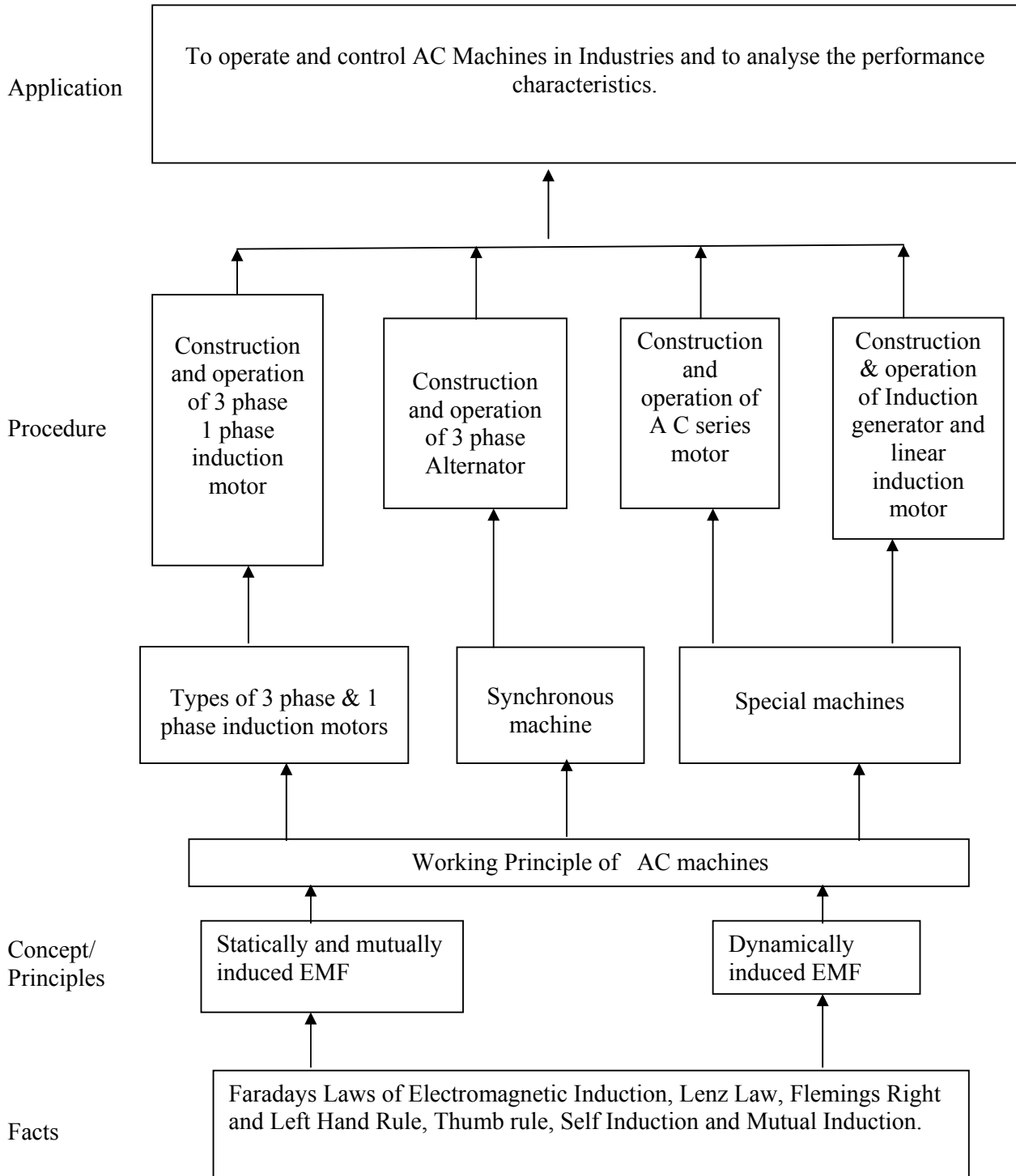
AC generators are used for generation of electricity in Thermal power stations, Hydro power stations, Nuclear power stations etc. The knowledge gained by the students is useful for studying technological subject such as Industry Electrical Systems, switchgear & protection, testing and maintenance of electrical equipment's and Modern electric traction.

The skills acquired after studying this subject will be helpful to operate & control the machines and also to find various operating parameters of machines.

Objectives:

Students will be able to:

1. To know the various types and constructional details of AC machines.
2. To understand the working principle various AC machines.
3. To operate various AC machines.
4. To apply the knowledge for testing of machines.
5. To coordinate the knowledge for understanding the other subjects.

Learning Structure:

Theory:

Topics and Contents	Hours	Marks
Topic 1: Three Phase Induction Motor Specific objectives: <ul style="list-style-type: none"> ➤ To know the construction /working principle of three phase I.M. ➤ To find synchronous speed and slip from given data. ➤ To differentiate between standstill and running condition of three phase Induction motor. ➤ To analyze Induction motor performance by performing O.C & S.C. test ➤ To choose the particular motor for proper applications. Contents: 1.1 Constructional and operational features: 12 Marks <ul style="list-style-type: none"> • Types of Three phase Induction motors • Construction of three phase induction motor • Production of rotating magnetic field with vector diagram. • Working Principle. • Concept of synchronous speed and slip (Numericals) • Comparison between squirrel-cage and slip-ring induction motor. • Equation of rotor induced emf frequency, current, reactance, impedance and rotor emf under standstill and running condition • Starting and running torque equation of squirrel cage and slip ring induction motor 	06	24
1.2 Characteristics : 12 Marks <ul style="list-style-type: none"> • Condition for maximum starting torque(Derivation) • Condition for maximum running torque (Derivation) • Torque slip characteristics of three phase induction motor • Effect of change in rotor circuit resistance on torque-slip characteristics • Effect of change in supply voltage on torque-speed • Ratio of full load torque and maximum torque (Numericals) • Ratio of starting torque and maximum torque (Numericals) • measurement of slip by • Tachometer method • Comparing rotor frequency and stator frequency • Stroboscopic method • Power stages of three phase induction motor. (Numericals) 	06	
Topic 2: Starting and Controlling of Induction Motor: <ul style="list-style-type: none"> • Starting of 3-phase IM (No numerical) <ul style="list-style-type: none"> a) Direct ON Line starter b) Stator resistance starter c) Star-Delta starter d) Auto transformer starter e) Rotor resistance starter • Speed control of three phase induction motor by <ul style="list-style-type: none"> a) Pole changing method b) Frequency control method c) By stator voltage control d) Rotor resistance control • Applications of three phase induction motor. 	04	10

<p>Topic 3: Three Phase Alternator</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ To know the construction /working principle of three phase Alternator. ➤ To find voltage regulation of alternator. ➤ To choose the particular alternator for proper applications. <p>Contents:</p> <p>3.1 Constructional features: 16 Marks</p> <ul style="list-style-type: none"> • Definition of Alternator • Construction of alternators • Working principle • Types of three phase alternators according to type of rotors • Relationship between synchronous speed and frequency • Armature winding- <ul style="list-style-type: none"> ✚ Single layer and double layer. ✚ Short pitch winding and short pitch factor. ✚ Distribution winding and distribution factor • Derivation of e.m.f. equation of Alternator (Numericals) 	06	28
<p>3.2 Operational features: 12 Marks</p> <ul style="list-style-type: none"> • Factors affecting the terminal voltage of Alternator <ul style="list-style-type: none"> a) Armature resistive drop b) Leakage reactance drop c) Armature reaction at various power factors • concept of Synchronous reactance and impedance • Regulation of three phase Alternator by <ul style="list-style-type: none"> a) Direct loading method b) Synchronous impedance method c) Amper turns method (Numericals on regulation) 	08	
<p>Topic 4: Parallel operation of Alternators:</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ To develop the skills for parallel operations and load sharing. • Need of parallel operation • Conditions for parallel operations • Synchronizing of three phase alternators <ul style="list-style-type: none"> a) lamp method b) Synchronoscope • Concept of Load sharing • Numericals on load sharing 	04	08
<p>Topic 5 : Single Phase Motors</p> <p>Specific objectives:</p> <ul style="list-style-type: none"> ➤ To understand the construction /working principle of single phase Induction motors. ➤ To understand the characteristics and applications of single phase Induction motor. <p>Contents:</p> <p>Constructional feature and characteristics :</p> <ul style="list-style-type: none"> • Types of Single phase IM • Double field revolving theory • Study of following single phase induction motors with respect to <ul style="list-style-type: none"> a. Construction 	06	12

b. Working principle c. Torque speed characteristics d. Applications <ul style="list-style-type: none"> i. Resistance start induction run ii. Capacitor start induction run iii. Capacitor start Capacitor iv. Shaded pole IM 		
Topic 6: Special Machines Specific objectives: <ul style="list-style-type: none"> ➤ To understand the construction /working principle of single phase Induction motors. ➤ To understand the working of Induction generator. Contents: Constructional feature and characteristics : <ul style="list-style-type: none"> • Study of following single phase induction motors with respect to <ul style="list-style-type: none"> a. Construction b. Working principle c. Torque speed characteristics d. Applications <ul style="list-style-type: none"> i. AC series motor ii. universal motor iii. Linear Induction Motor • Introduction to Induction Generator • Construction, Working Principle and Applications of : <ul style="list-style-type: none"> • D. C. and A. C. Servomotor • Stepper Motor: variable reluctance, permanent magnet and hybrid type 	08	18
Total	48	100

Practicals:**Skills to be developed:****Intellectual Skills:**

1. Understand the concept of working principle of Three phase induction motors.
2. Understand the concept of rotating magnetic field in Induction machines.
3. Realise the concept of slip and slip measurement.
4. Know the effect of stator voltage and frequency variations on speed of induction motor.
5. Know the starting methods of synchronous motor.

Motor Skills:

1. Ability to start and run induction motor.
2. Ability to change the direction motor.
3. Ability to feed variable frequency supply to induction motor and control its speed.
4. Ability to operate and control the machines.
5. Ability to take the precautions while operating the machines.
6. Ability to draw the characteristics and interpret the result.
7. Ability to draw the circle diagram and interpret the results.

List of Practicals:

1. A) To connect Direct On Line starter (DOL) for starting three phase squirrel cage Induction motor and reverse the direction of rotation.
B) To connect rotor resistance starter for starting and speed control of three phase slip ring Induction motor.
2. To measure the slip of 3-phase IM by
 - i) Tachometer
 - ii) Comparing rotor & stator frequency
 - iii) Stroboscopic method.
3. To control the speed of three phase Induction motor by stator voltage variation and variable frequency supply.
4. To perform direct load test on three phase Induction motor and plot its performance characteristics.
5. To determine the percentage voltage regulation by direct loading at unity, lagging and leading power factor load.
6. To determine percentage voltage regulation of three phase alternator by synchronous impedance method at full load for unity, 0.8 lagging and 0.8 leading p.f.
7. To determine percentage voltage regulation of three phase alternator by Amper turns method at full load for unity, 0.8 lagging and 0.8 leading p.f.
8. To synchronize the incoming machine (Alternator) with Bus-Bar.
9. To identify different windings and components of single phase capacitor Induction run motor or ceiling fan. Connect to start and reverse direction of rotation.

Learning Resources:**1. Books:**

Sr. No.	Author	Title	Publisher
1	B. L. Theraja	Electrical Technology Vol-II	S. Chand & Co.
2	S. K. Bhattacharya	Electrical Machines	Tata McGraw Hill Pub Co. Ltd. New Delhi
3	K Murugesh Kumar	Electrical Machines Vol-II	Vikas publication House Pvt. Ltd.
4	K Murugesh Kumar	Induction and Synchronous Machines	Vikas publication House Pvt. Ltd.
5	M. G. Say	The performance and design of alternating current machines	CBS Publication
6	D. P. Kothari & I. P. Nagrath	Electric Machines	Tata McGraw Hill Pub Co. Ltd. New Delhi

2. IS, BIS and International Codes:

1. All motors comply with the following Indian and international standards:

IS 325	Three phase Induction motors-specification
IS:900	Code of practice for installation and maintenance of induction motors
IS 1231	Dimension of three-phase foot mounted A.C. Induction motors
IS 2223	Dimensions of flange mounted A.C. induction motors
IS:4029	Guide for testing three phase induction motors
IS:4691	Degree of protection provided by Enclosures for Rotating Electrical Machinery
IS:6362	Designation of methods of cooling for rotating electrical machines

IS 12065	Permissible limits of noise level for rotating electrical machines
IS 12075	Mechanical vibration of rotating electrical machines
IS 12615	Energy Efficient Induction motors - Three phase, squirrel cage
IEC 60045-1, 5	Rotating electrical machines - Rating and performance, degrees of protection
IEC 60072	Dimension and output ratings of rotating electrical machines

BIS: Bureau of Indian Standards

<http://www.bis.org.in/>

Sr. No.	Amendment to IS	Description of Amendment
01	Amendment No.3 to IS 4889:1968	Methods of Determination of Efficiency of Rotating Electrical Machines
02	Amendment No.2 to IS 14665(Pt 2/Sec 1) : 2000	Electric Traction Lifts Part 2 Code of Practice for Installation Operation and Maintenance: Section 1 Passenger and Goods Lifts
03	Amendment No.1 to IS 14578:1999	Three - Phase Induction Motors for use in Nuclear Power Plants : Specifications

Websites:

1. http://www.engineersedge.com/motors/alternators_types.htm
2. http://www.tpub.com/contents/neets/14177/css/14177_82.htm
3. http://www.learn-about-electronics.com/Three-Phase_alternator.html
4. <http://www.learn-about-electronics.com/AC-current-motors.html>
5. http://www.tpub.com/content/neets/12177/css/14177_65.htm
6. <http://www.tpub.com/neets/book2/1c.htm>
7. http://www.allaboutcircuits.com/vol_2/chpt_13/8.html
8. <http://www.tecowestinghouse.com/PDF/woundrotor.pdf>
9. http://en.wikipedia.org/wiki/Electric_motor#Induction_motor
10. http://en.wikipedia.org/wiki/Synchronous_motor
11. <http://synchronousmotor.specaproduct.com/>
12. http://www.engineersedge.com/motors/synchronous_motor.htm
13. <http://www.eolss.net/Sample-Chapters/C05/E6-39A-05-03.pdf>
14. http://www.allaboutcircuits.com/vol_2/chpt_13/9.html
15. http://www.allaboutcircuits.com/vol_2/chpt_13/10.html
16. <http://dcacmotors.blogspot.in/2009/04/capacitor-start-single-phase-induction.html>
17. <http://www.newagepublishers.com/samplechapter/001136.pdf>
18. <http://www.wisc-online.com/objects/ViewObject.aspx?ID=IAU10908>
19. <http://www.hvactroubleshootingguides.com/resistance-start-induction-run-motor.html>
20. <http://www.hvactroubleshootingguides.com/capacitor-start-induction-run-motor.html>
21. <http://www.ustudy.in/node/4753>
22. <http://www.woodward.co.kr/storage/files/parallel%20operation%20of%20alternators.pdf>
23. http://en.wikipedia.org/wiki/Electric_motor#Universal_motors
24. <http://www.ustudy.in/node/6382>
25. http://en.wikipedia.org/wiki/AC_motor
26. http://en.wikipedia.org/wiki/Linear_induction_motor
27. <http://www.britannica.com/EBchecked/topic/182667/electric-motor/45833/Linear-induction-motors>
28. <http://www.msbte.com/website/curriculum/Lab Manual of 5th Semester/ACMachines.pdf>

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/EE/EP/CH/PS/CD/ED/EI/CV/FE/FG/IU/MH/MI/TX/TC/DC/AU

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

Subject Title : Behavioural Science

Subject Code : 17075

Teaching and Examination Scheme:

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
01	--	02	--	--	--	25 #	25 @	50

Rationale:

With increased globalization and rapid changing business expectations, employers are looking for wide cluster of skills to cater to the changing demand. Personality traits and soft skills are playing a key role in a student's career in this changing scenario. Corporate houses look for soft skills that supplement hard skills.

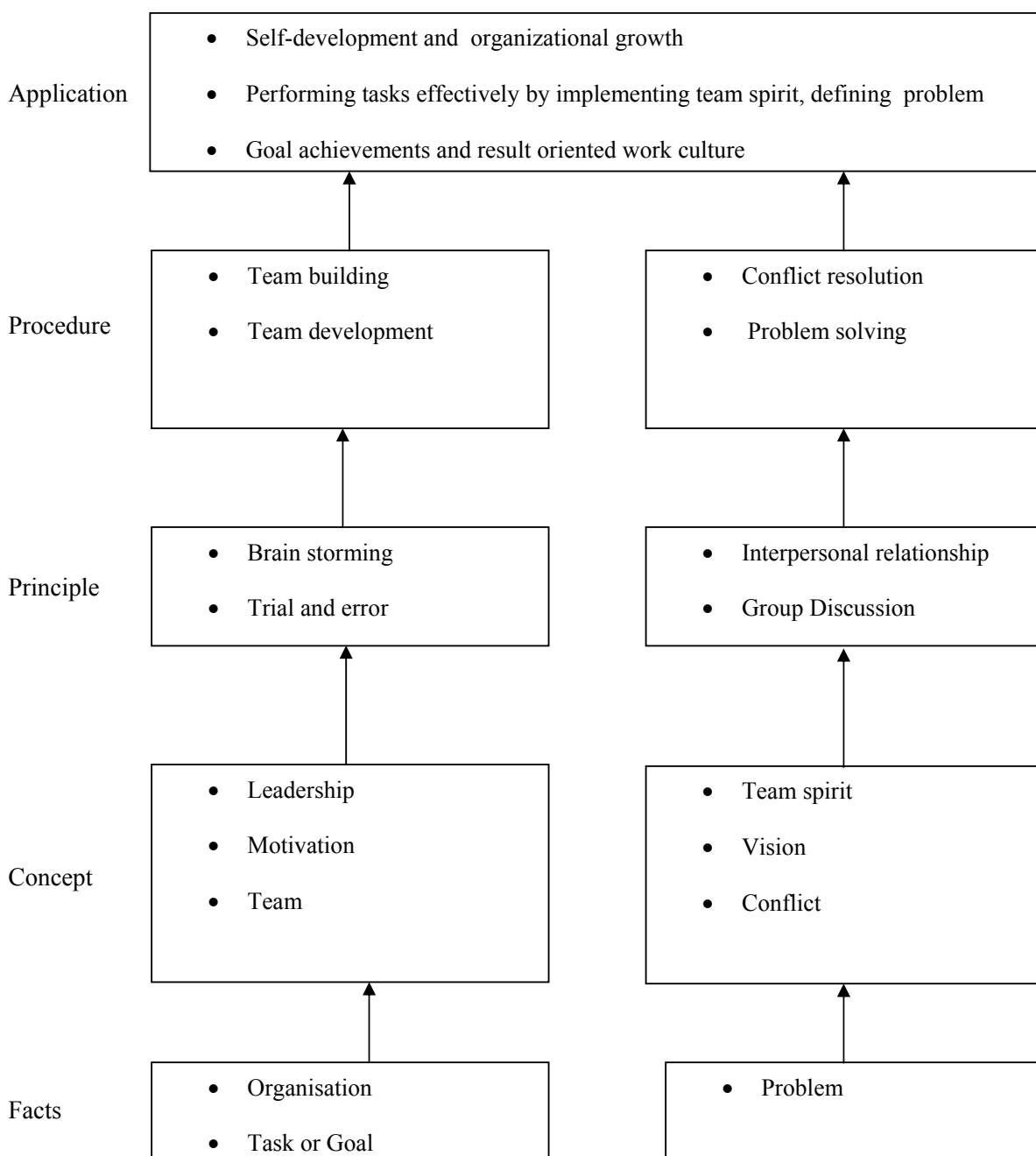
Addition of behavioural science in curriculum is intended to enhance the efficiency of a person so that he can contribute to overall growth of organisation. It aims at developing insight into leadership, team building, motivation, interpersonal relationship, problem solving, decision making and aspects of personality in a technician's profile. Addition of the topic of organizational culture will further mould him/ her in the organisational role.

This subject of 'Behavioural Science' provides a broad base in which a technician can develop a successful career in the world of work.

General Objectives:

After studying this subject, the students will be able to:

1. Develop him/her as Team leader.
2. Use self-motivation and motivate others.
3. Build a team and develop team spirit among the team members.
4. Improve the interpersonal relationship skills.
5. Learn Problem solving and decision making skills.
6. Discuss a particular topic in a group and face the interview.

Learning Structure:

Theory:

Topic and Contents	Hours
Topic 1: LEADERSHIP Contents: 1.1 Introduction – Importance, examples of different types of leaders. 1.2 Meaning and Definition of Leadership. 1.3 Leadership qualities – Confidence, Vision, Communication Skills, influencing people etc. 1.4 Types of Leadership styles, their advantages and disadvantages – Autocratic, Democratic, Delegative, Bureaucratic and Laissez Fairie.	02
Topic 2: MOTIVATION Contents: 2.1 Meaning and Definition of motivation. 2.2 Types of motivation. 2.3 Maslow’s Motivation theory. 2.4 Job characteristic model to enhance motivation.	03
Topic 3: TEAM BUILDING Contents: 3.1 Definition of Team. 3.2 Difference between Group and Team. 3.3 Need for formation of good team (vision, trust, cooperation, initiative, etc.) 3.4 Approach to Team building (Personality based, activity based, skill based, problem solving based, etc.)	02
Topic 4: CONFLICT RESOLUTION Contents: 4.1 Definition of Conflict. 4.2 Types of Conflict – Functional and Dysfunctional 4.3 Sources of Conflict – Ego, Authority, Frustration etc. 4.4 Positive and Negative effects of conflicts. 4.5 Methods of Conflict resolution – Compromising, withdrawal, forcing.	04
Topic 5: PROBLEM SOLVING AND DECISION MAKING Contents: 5.1 Steps in Problem Solving. 5.2 Methods used for solving problems – trial and error method, brain storming, lateral thinking method. 5.3 Techniques used for Decision making- Decision tree, Decision Matrix, Mind Mapping etc.	03
Topic 6: GROUP DISCUSSION AND INTERVIEW TECHNIQUES Contents: 6.1 GROUP DISCUSSION <ul style="list-style-type: none"> Objectives of Group Discussion (ability to work in team, speaking and listening skills, leadership, creativity) Does and Don’ts of Group Discussion. How to conclude Group Discussion. 	02

6.2 INTERVIEW TECHNIQUES	
<ul style="list-style-type: none"> Types of Interviews. (patterned, stress, behavioural) Dress Code, Body Language and Communication Skill. Probable questions for Interview. Telephonic or Video Interview. 	
Total	16

Practical:**Skills to be developed:****Intellectual Skills:**

- Develop ability to find his strengths.
- Select proper source of information.
- Follow the technique of time and stress management.
- Set the goal.

Motor Skills:

- Follow the presentation of body language.
- Work on internet and search for information.
- Prepare slides / transparencies for presentation.

List of Practicals / activities:

- Form a group of 4 or 5 students and discuss the topic 'Qualities of an effective leader'. Each group will prepare its list with justification to the entire class and write an assignment under the guidance of subject teacher.
- Form a pair of student and each one from pair will ask each other questionnaire on motivation, self-motivation, experiences that motivated him or other which him for success in the past and write an assignment under the guidance of subject teacher based on discussion.
- Form a group of 4 or 5 students and assign them a group activity such as 'making a shape from match stick (50 to 100 match sticks) without guidance and without group discussion.
- The group as in activity 3 will now perform the same activity. After group discussion and under guidance of subject teacher, each student from a group will write an assignment for both the activities and write their inferences with reference to group discussion, team development, team building, etc.
- Form a group of 8 to 10 student and arrange a group activity such as;
 - Industrial visit.
 - Visit to any historical place/fort/museum, etc
 - Housekeeping and cleaning of any laboratory/seminar hall for any function.
 After the execution of activity student will write an assignment under guidance of teacher keeping in mind individual role, purpose of activity, inter dependency of work or task, coordination of person and task involved and final performance.
- Write an assignment on interpersonal relationship and conflict management with student's personal experience of solving conflicts.
- Form a group of 20 students and ask them to prepare a list of 8 to 10 problems affecting the institute. Subject teacher should analyze one such problem on black board using 'Fish bone technique' with the participation of students. Students will write an assignment consisting;
 - Apparent problem statement.
 - Analysis of the causes.
 - Definition of real problem.

8. The subject teacher starts the session with ‘Statement of the problem’ written on the black board. After ensuring that all the participants are at the same level of understanding the statement of problem, he initiates NGT (Normal Group Technique) to arrive at maximum possible number of creative solutions.
Based on ranking matrix the group will arrive at feasible solutions and students will write an assignment consisting of;
 - Problem Statement.
 - Model of problem solving.
 - List of creative solution suggested by participants.
 - Write the most feasible solution based on given criteria.
9. Form a group of 4 to 5 students and give them a topic for GD for 10 to 15 minutes. Teacher should analyse GD on certain parameters and students will write an assignment on aspects of GD and prepare a format (suggested or designed by teacher) which gives details of GD carried out.
10. Arrange a guest lecture of H.R. Person from industry/expert in interview technique and conduct mock interview of each student. Student should write a report on this activity.
11. Arrange a visit to industry and gather information about organisation, product, turnover, work culture, vision/mission statement, quality policy, Corporate social responsibility etc. and write a report on it.

Note - Subject teacher shall guide the students in completing the assignments based on above practicals.

Learning Resources:

Books:

Sr. No.	Author	Name of Book	Publication
1	Subject Experts-MSBTE	Handbook and assignment book on Development of Life Skills-II	MSBTE
2	Dr. Kumkum Mukherjee	Principles of management and organizational behaviour	Tata McGraw Hill Education Pvt Ltd.
3	Dr.T.Kalyana Chakravarti Dr.T.Latha Chakravarti	Soft Skills for Managers	Biztantra
4	Barun K Mitra	Personality Development and Soft Skills	Oxford University Press
5	Priyadarshini Patnaik	Group discussion and interview skills	Foundation Books

Course Name : Electrical Engineering Group**Course Code : EE / EP****Semester : Fifth****Subject Title : Entrepreneurship Development and Industrial Project****Subject Code : 17059****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS.	TH	PR	OR	TW	TOTAL
01	01	02	--	--	--	--	25@	25

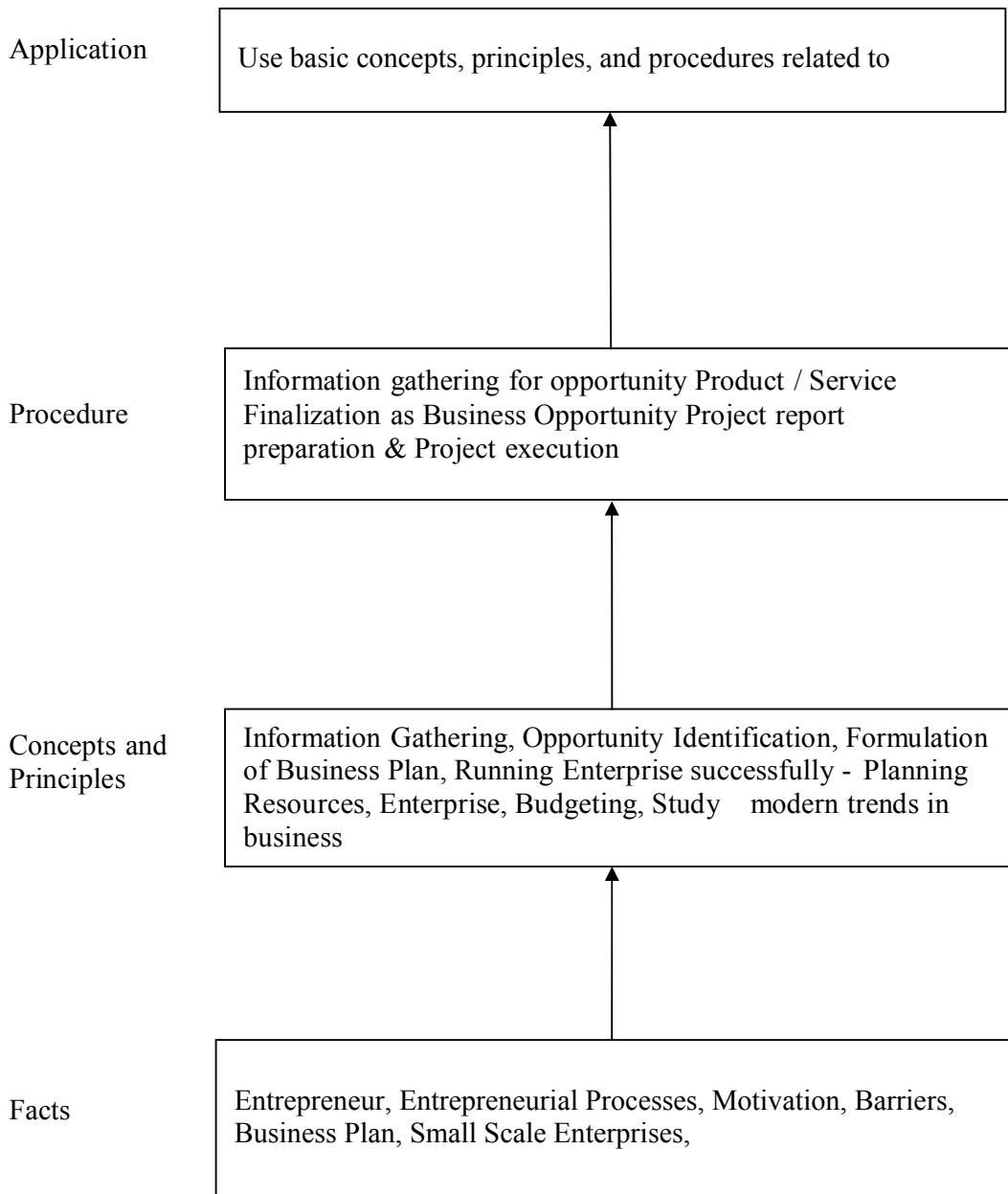
Part A: Entrepreneurship Development**Rationale:**

Globalization, liberalization & privatization along with revolution in Information Technology, have thrown up new opportunities that are transforming lives of the masses. Talented and enterprising personalities are exploring such opportunities & translating opportunities into business ventures such as- BPO, Contract Manufacturing, Trading, Service sectors etc. The student community also needs to explore the emerging opportunities. It is therefore necessary to inculcate the entrepreneurial values during their educational tenure. This will help the younger generation in changing their attitude and take the challenging growth oriented tasks instead of waiting for white-collar jobs. This subject will help in developing the awareness and interest in entrepreneurship and create employment for others.

Objectives:

Students will be able to

- 1) Identify entrepreneurship opportunity.
- 2) Acquire entrepreneurial values and attitude.
- 3) Use the information to prepare project report for business venture.
- 4) Develop awareness about enterprise management.

Learning Structure:

Topic	Name of Topic	Hours
01	Entrepreneurship, Creativity & Opportunities <ul style="list-style-type: none"> • Concept, Classification & Characteristics of Entrepreneur • Creativity and Risk taking, Risk Situation, Types of risk & risk takers. • Business Reforms. • Process of Liberalization. • Reform Policies. • Impact of Liberalization. • Emerging high growth areas. • Business Idea Methods and techniques to generate business idea. • Transforming Ideas in to opportunities transformation involves • Assessment of idea & Feasibility of opportunity • SWOT Analysis 	03
02	Information and Support Systems <ul style="list-style-type: none"> • Information Needed and Their Sources: • Information related to project, Information related to support system, Information related to procedures and formalities • Support Systems • Small Scale Business Planning, Requirements. • Govt. & Institutional Agencies, Formalities • Statutory Requirements and Agencies. 	02
03	Market Assessment <ul style="list-style-type: none"> • Marketing - Concept and Importance • Market Identification, Survey Key components • Market Assessment 	02
04	Business Finance & Accounts <ul style="list-style-type: none"> ➤ Business Finance <ul style="list-style-type: none"> • Cost of Project • Sources of Finance • Assessment of working capital • Product costing • Profitability • Break Even Analysis • Financial Ratios and Significance ➤ Business Account <ul style="list-style-type: none"> • Accounting Principles, Methodology • Book Keeping • Financial Statements • Concept of Audit 	03

05	Business Plan & Project Report <ul style="list-style-type: none"> • Business plan steps involved from concept to commissioning Activity Recourses, Time, Cost • Project Report • Meaning and Importance • Components of project report/profile (Give list) <p>5.1) Project Appraisal</p> <p>1) Meaning and definition 2) Technical, Economic feasibility 3) Cost benefit Analysis</p>	03
06	Enterprise Management And Modern Trends <ul style="list-style-type: none"> ➤ Enterprise Management: <ul style="list-style-type: none"> • Essential roles of Entrepreneur in managing enterprise • Product Cycle: Concept and importance • Probable Causes Of Sickness • Quality Assurance: Importance of Quality, Importance of testing • E-Commerce: Concept and Process ➤ Global Entrepreneur <ul style="list-style-type: none"> • Assess yourself-are you an entrepreneur? • Prepare project report and study its feasibility. 	03
Total		16

List of Assignments:

1. Write the SWOT Analysis required for an successful entrepreneur.
2. Collect the required information, formalities and supporting systems for starting a small scale business.
3. Collect information regarding key parameters required for market analysis of an electrical industry.
4. Search for current available sources of finance to start a new business and write a report.
5. Write a report on different accounting methods, financial statements and audit.
6. Write a report on preparing a good business plan.
7. Collect information on E-commerce system and write a report on how it is useful for entrepreneurs.
8. Prepare a report on how to become a successful entrepreneur?

Learning Resources:**1) Books:**

Sr. No	Author	Title	Publisher
1	J.S. Saini B.S.Rathore	Entrepreneurship Theory and Practice	Wheeler Publisher, New Delhi
2	Prepared by Colombo plan staff college for Technician Education.	Entrepreneurship Development	Tata Mc Graw Hill Publishing co. ltd. New Delhi.

3	J. B. Patel D. G. Allampally	A Manual on How to Prepare a Project Report	EDI STUDY MATERIAL Near Village Bhat , Via Ahmadabad Airport & Indira Bridge, P.O. Bhat 382428 , Gujrat, India P.H. (079) 3969163, 3969153 E-mail : ediindia@sancharnet.in / olpe@ediindia.org Website : http://www.ediindia.org
4	Gautam Jain Debmuni Gupta	New Initiatives in Entrepreneurship Education & Training	
5	Schaper, Michael Volery	Entrepreneurship-Small Business	Wiley India, 2011
6	Alpana, Trehan	Entrepreneurship	Dreamtech, 2011

2) Video Cassettes:

No	Subject	Source
1	Five success Stories of First Generation Entrepreneurs	EDI STUDY MATERIAL Ahmadabad (Near Village Bhat , Via Ahmadabad Airport & Indira Bridge), P.O. Bhat 382428 , Gujrat, India P.H. (079) 3969163, 3969153 E-mail : ediindia@sancharnet.in / olpe@ediindia.org Website : http://www.ediindia.org
2	Assessing Entrepreneurial Competencies	
3	Business Opportunity Selection and Guidance	
4	Planning for completion & Growth	
5	Problem solving-An Entrepreneur Skill	

PART B) Industrial Project

Following activities related to project are required to be dealt with, during this semester

1. Form project batches & allot project guide to each batch. (Max. 4 students per batch)
2. Each project batch should select topic / problem / work by consulting the guide & / or industry. Topic / Problem / work should be approved by Head of department.
3. Each project batch should prepare action plan of project activities & submit the same to respective guide.
4. At the end of semester, each project batch should submit the action plan and abstract of the project along with list of materials required if project involves fabrication or other facilities required in other kinds of project.
5. Action Plan should be part of the project report.
6. Each group member shall write assignments on the action plan prepared for the project for this semester (half of the project work). The assessment of the assignments will be considered for next semester as a total term work.

Group	Project
01	(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. (4) Substation Model (Scaled) (5) Wind Turbine Model (Scaled) (6) Pole Mounted Substation Model (Scaled) (7) Industrial Automation (8) Non-conventional Energy Hybrid Models
02	(1) Rewinding of Three Phase/Single Phase Induction Motor. (2) Rewinding of Single Phase Transformer. (3) Fabrication of Inverter up to 1000 VA. (4) Fabrication of Battery Charger. (5) Fabrication of Small Wind Energy System for Battery Charging. (6) Fabrication of Solar Panel System for Battery Charging. (7) Microprocessor/ Micro controller Based Projects. (8) PC Based Projects. (9) Simulation/ Automation Projects
03	(1) Case study on Energy Conservation & Audit (2) Case Study on Design schemes of lighting, transformers, motors, power system, protection system (3) Case study on improvement, modification, advancement in existing systems or technologies (4) Case study on latest techniques like insulation technology, digital systems, fibre optics, silicon technology, nanotechnology etc.

Course Name : Electrical Engineering Group**Course Code : EE / EP****Semester : Fifth****Subject Title : Professional Practices - III / Industrial Training****Subject Code : 17060****Teaching and Examination Scheme:**

Teaching Scheme			Examination Scheme					
TH	TU	PR	PAPER HRS	TH	PR	OR	TW	TOTAL
--	--	03	--	--	--	--	50@	50

Notes: The teachers are encouraged to develop a “Speakers Bank”, a list of various experts from Industry and Educational Institutes who can speak on different topics. Similarly they should also prepare a directory of various nearby industries from their branch of Engineering, where the students can visit. Preferably, the students should visit the industries in a batch of not more than 20. Where possible, the polytechnics should encourage the students to visit nearby industries during winter or summer vacations, for a period of 1 to 2 weeks and prepare a detail report and this can be included in the report of “Industrial Visit” in Professional Practice, scheduled for the next semester.

Rationale:

In the changing world scenario, the Diploma Engineers are expected to acquire various skills which include ability to communicate effectively, to present a topic, to share ideas, to prepare reports etc. and shape up their own personality. They are also expected to acquire technical information on various topics related to their branch of study, in addition to the various subjects included in their curriculum.

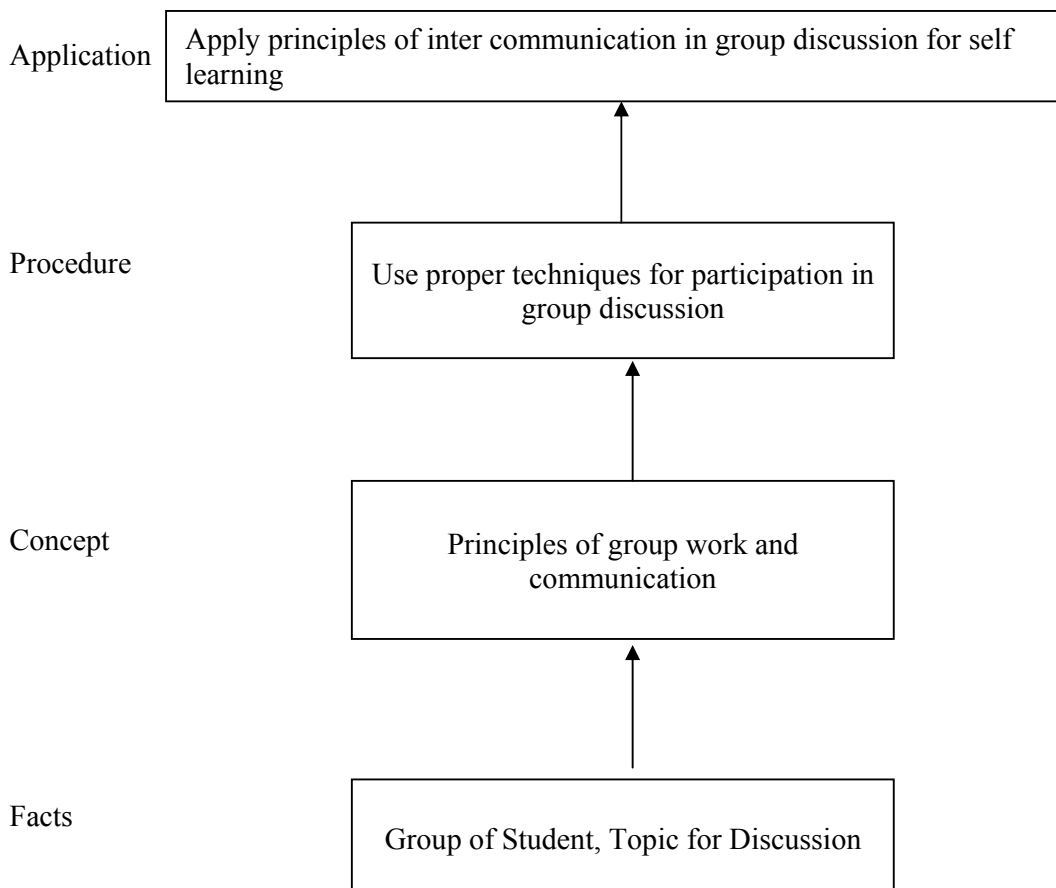
These acquired skills and enhanced confidence level are going to help them get a good job, based on personal interviews and aptitude tests.

Visits to various nearby industries, lectures on technical subjects by experts, seminars on variety of subjects, group discussion, browsing internet and collection of information, preparing reports are some of the activities suggested under Professional Practice.

General 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:

Activities	Hours
1. Industrial Visits: Structured industrial visits be arranged and report of the same should be submitted by the individual student, to form a part of the term work. Following are the suggested type of Industries/ Fields – (Minimum three visits). <ul style="list-style-type: none"> • Visit to 220kv/110kv sub- station • Visit to Railway Station to study operation of Signaling system • Visit to L & T LT Switchgear Training Center at Pune. • Visit to Maintenance Department of sugar industry. • Visit to Loco shed or EMW at Nashik. • Visit to a Foundry to see Furnaces and Ovens • Visit to industry to observe function of DAS and SCADA, • Visit to industry to observe Automation for manufacturing processes. 	18
2. Lectures by Professional / Industrial Expert to be organized on any Two topics of the following suggested areas or any other suitable topics: <ul style="list-style-type: none"> • Eco friendly Air Conditioning/Refrigeration • Functioning of Electricity Regulatory Commission • Recent Modifications in IE Rules • Modern trends in A. C. Machines. • Testing of Switchgears • Recent trends in Power Generation(micro-power/distributed generation) • Interview Techniques. • Computer Aided Drafting. • i) Importance of non - conventional energy sources (All types). 	08
3. Group Discussion: The students should discuss in group of four to six students and write a brief report on the any one from below given topics as part of term work. Any other topic for group discussions may be selected by the faculty members. Some of the suggested topics are - <ul style="list-style-type: none"> • Energy saving in the institute/residential/industry/commercial. • Role of Electrical Engineer in disaster management. • Safety precautions in electrical engineering. • Scope of outsourcing of Electrical Engineering services. • Disposal of electrical/electronic waste (e-waste). • Global warming. 	06
4. Information Search: The students should collect information individually and write a report on the any one from below given topics as part of term work. Any other topic for information search may be selected by the faculty members. Some of the suggested topics are - <ul style="list-style-type: none"> • Formalities/documentation required to obtain residential electrical connection (Form number A1 & D1). • Study of residential electricity bill. • Collect information related to the areas of employment & duties & responsibilities for diploma electrical engineers through employment advertisement in daily newspaper. • State and National Statistics for Power Generation. 	08

<ul style="list-style-type: none"> • Comparison of Cost per unit generated by various methods of Power Generation. • Special features of metro railways. • g) Recent trends in Power Generation (micro-power/distributed generation). 	
5.Seminar : Seminar topic should be related to the topics from above serial numbers 01- industrial visits, 02-guest lectures, 03- information search. Each student shall submit a report of at least 10 pages and deliver a seminar (Presentation time – 10 minutes).	08
Total	48

OR**Industrial Training (Optional):**

For the students who have undergone industrial training of four weeks duration in the summer vacation of fourth semester will be assessed as follows:

1. Industrial Training report duly certified by competent authority in the industry: **30 Marks**
2. Seminar on industrial training: **20 Marks**

Industrial Training (Optional)

- Students who have completed industrial training in summer vacation after 4th Semester will be granted exemption for activities related to topic 1 to 4.
- These students shall submit report of Industrial training signed and certified by authorities from Industry. Student will give seminar on industry training attended by him.
- Evaluation will be done on seminar and report submitted by student.