
 <b>MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI</b> <b>TEACHING AND EXAMINATION SCHEME FOR POST S.S.C. DIPLOMA COURSES</b>																	
<b>COURSE NAME : DIPLOMA IN ELECTRICAL ENGINEERING</b>																	
<b>COURSE CODE : EC</b>																	
<b>DURATION OF COURSE : EIGHT SEMESTERS</b>									<b>WITH EFFECT FROM 2013-14</b>								
<b>SEMESTER : FIFTH</b>									<b>DURATION : 16 WEEKS</b>								
<b>PATTERN : CORRESPONDANCE - SEMESTER</b>									<b>SCHEME : G</b>								
SR. NO	SUBJECT TITLE	abbrevi ation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17905)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Electrical & Electronic Measurement	EEM	17967	07	01	24	03	100	40	50#	20	--	--	25@	10	50	
2	Transmission & Distribution of Electrical Power	TDE	17968	07	01	--	03	100	40	--	--	--	--	--	--		
3	D.C.Machines & Transformers	DMT	17969	07	01	24	03	100	40	50#	20	--	--	25@	10		
4	Computer Programming	CPR	17970	--	--	24	--	--	--	--	--	25#	10	25@	10		
<b>Total</b>				<b>21</b>	<b>03</b>	<b>72</b>	<b>--</b>	<b>300</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>25</b>	<b>--</b>	<b>75</b>	<b>--</b>	<b>50</b>	
<b>TOTAL CONTACT HOURS DURING RESIDENT SESSION: 96 HRS [15 days * 8 hrs per day]</b>																	
Total Marks : <b>550</b>																	
@ - Internal Assessment, # External Assessment, <span style="background-color: #cccccc; padding: 2px;"> </span> No Theory Examination, * Online Examination.																	
Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work																	
<b>NOTE:</b>																	
1. HOURS MARKED BY * FOR INTERNAL PRACTICAL EXAMINATION TO BE CONDUCTED AT RESSIDENT SESSION.																	
2. <b>ONE TEST OF 25 MARKS</b> TO BE CONDUCTED AT RESIDENT SESSION AND MARKS TO BE SUBMITTED TO GPDL PUNE.																	
3. 240 HOURS FOR SELF STUDY AT HOME.																	
4. ALL PRACTICALS/ORAL EXAMS [EXTERNAL ASSESSMENT INDICATED BY #] TO BE CONDUCTED AT EXAM CENTRE.																	
5. ORAL EXAMINATION [INTERNAL ASSESSMENT @] TO BE CONDUCTED AT EXAM CENTRE.																	
6. INTERNAL ASSESSMENT @ OF TERM WORK WILL BE DONE AT RESIDENT SESSION.																	

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<b>COURSE NAME : DIPLOMA IN ELECTRICAL ENGINEERING</b>																	
<b>COURSE CODE : EG</b>																	
<b>DURATION OF COURSE : EIGHT SEMESTERS</b>										<b>WITH EFFECT FROM 2013-14</b>							
<b>SEMESTER : FIFTH</b>										<b>DURATION : 16 WEEKS</b>							
<b>PATTERN : PART TIME - SEMESTER</b>										<b>SCHEME : G</b>							
SR. NO	SUBJECT TITLE	abbrevi ation	SUB CODE	TEACHING SCHEME			EXAMINATION SCHEME										SW (17905)
				TH	TU	PR	PAPER HRS.	TH (1)		PR (4)		OR (8)		TW (9)			
								Max	Min	Max	Min	Max	Min	Max	Min		
1	Electrical & Electronic Measurement	EEM	17967	03	--	02	03	100	40	50#	20	--	--	25@	10	50	
2	Transmission & Distribution of Electrical Power	TDE	17968	04	--	--	03	100	40	--	--	--	--	--	--		
3	D.C.Machines & Transformers	DMT	17969	04	--	02	03	100	40	50#	20	--	--	25@	10		
<b>Total</b>				<b>11</b>	<b>--</b>	<b>04</b>	<b>--</b>	<b>300</b>	<b>--</b>	<b>100</b>	<b>--</b>	<b>--</b>	<b>--</b>	<b>50</b>	<b>--</b>	<b>50</b>	
Student Contact Hours Per Week: <b>15 Hrs.</b> <b>THEORY AND PRACTICAL PERIODS OF 60 MINUTES EACH.</b> Total Marks : <b>500</b> @ - Internal Assessment, # External Assessment, <span style="background-color: #cccccc; display: inline-block; width: 1em; height: 1em; vertical-align: middle;"></span> No Theory Examination, * Online Examination.																	
Abbreviations: TH-Theory, TU- Tutorial, PR-Practical, OR-Oral, TW- Term Work, SW- Sessional Work																	
<ul style="list-style-type: none"> <li>➤ 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).</li> <li>➤ Progressive evaluation is to be done by subject teacher as per the prevailing curriculum implementation and assessment norms</li> <li>➤ Code number for TH, PR, OR, TW are to be given as suffix 1, 4, 8, 9 respectively to the subject code.</li> </ul>																	

**Course Name : Diploma in Electrical Engineering****Course Code : EG / EC****Semester : Fifth****Subject Title : Electrical & Electronic Measurement****Subject Code : 17967****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).**

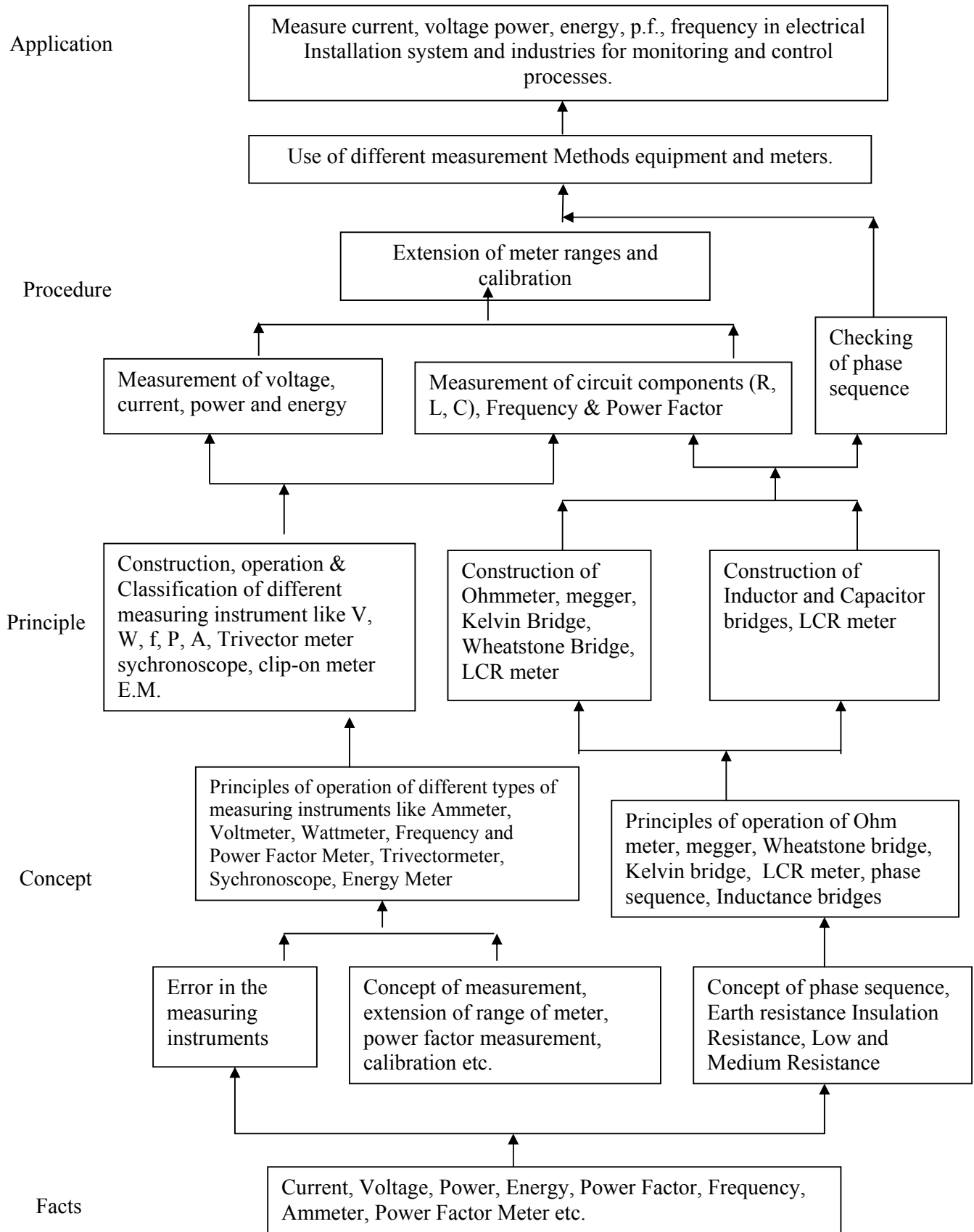
**Rationale:**

This is the core technology subject. The electrical diploma holder has to work in industry as technical person in middle level management. He has to work as production, maintenance, testing engineer in various industries like power generation, transmission, distribution, traction etc. and has to deal with different electrical machines and equipments. While performing above task he has to measure different electrical parameters and quantities therefore he must require the skills for these measurements and broad idea of different meters and equipments.

**General Objectives:****The Students will be able to: -**

1. To know the vocabulary of electrical measurement system
2. Identify various measuring instruments
3. To read different meters properly
4. Select proper meter / equipment for particular measurement
5. calibrate various types of meters/ instruments as per ISS

**Learning Structure:**



**Theory:**

Topics and contents	Hours	Marks
<p><b>Topic 1: Fundamentals of Measurements.</b></p> <ul style="list-style-type: none"> <li>➤ Understand different terms in measurement system.</li> <li>➤ Explain development of different torques in measurement system.</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Significance and purpose of electrical measurement systems.</li> <li>• Various electrical effects employed in measuring instruments.</li> <li>• Desirable characteristics of measuring instruments: accuracy, sensitivity, selectivity, reproducibility, precision, errors, drift</li> <li>• Common errors in analog measuring instruments.</li> <li>• Classification of measuring instruments.</li> <li>• Different torques in analog instruments: Deflecting, controlling and damping torque. <ul style="list-style-type: none"> <li>➤ Methods of developing these torques</li> </ul> </li> </ul>	07	14
<p><b>Topic 2: Measurement of Voltage and Current.</b></p> <ul style="list-style-type: none"> <li>➤ Identify different parts of indicating instruments.</li> <li>➤ Select proper meter for particular application.</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Constructional features and working principles used in PMMC and MI instruments.</li> <li>• Comparison between PMMC and MI instruments.</li> <li>• Basic arrangements of using above instruments for measurement of voltage and current in single phase circuits.</li> <li>• Extension of Range of ammeters and voltmeters. <ul style="list-style-type: none"> <li>➤ D. C. Ammeters: Using Shunts: calculations of shunt resistance and simple numerical</li> <li>➤ D. C. Voltmeters: Using Multipliers: calculations of multiplier resistance and simple numericals</li> <li>➤ A. C. Ammeters: Using Current transformers: Construction and principle of operation, precautions</li> <li>➤ A. C. Voltmeters :Using Potential transformers Construction and principle of operation, precautions</li> </ul> </li> <li>• Calibration of Ammeter and Voltmeter: Concept of Standard meter, Calibration Procedure</li> </ul>	10	24
<p><b>Topic 3: Concept of Power and Power Measuring Instruments:</b></p> <ul style="list-style-type: none"> <li>➤ Know Significance of power factor in power measurement.</li> <li>➤ Use appropriate method for power measurements using wattmeter</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Concept of impedance triangle in A.C. circuit-R-L,R-C and R-L-C series circuit.</li> <li>• Concept of Power factor and its significance.</li> <li>• Active, Reactive and apparent power, their equations, relations and units.</li> <li>• Power Triangle : concept of lagging and leading power factor</li> <li>• Constructional features of Dynamometer type instruments and its use as a wattmeter for single phase circuits.</li> <li>• Multiplying factor of wattmeter.</li> <li>• Different errors in wattmeter and their compensations.</li> </ul>	06	12
<b>Topic 4: Measurement of three phase a. c. Power</b>	06	12

<ul style="list-style-type: none"> <li>➤ Use appropriate methods for measurement of 3-ph Power</li> <li>➤ Verify power measured analytically and by using phasor diagrams</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• One wattmeter method: Measurement of active and reactive power. Advantages and Limitations</li> <li>• Two wattmeter method: Measurement of active and reactive power. Advantages and Limitations</li> <li>• Effect of Power factor on wattmeter reading in two wattmeter method.</li> <li>• Extension of ranges</li> </ul> <p><b>(Simple numericals on above )</b></p>		
<p><b>Topic 5: Measurement of Electrical Energy</b></p> <ul style="list-style-type: none"> <li>➤ Make connections of single phase energy meter.</li> <li>➤ Calibrate 1-ph energy meter</li> <li>➤ Choose energy meter of appropriate rating</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Concept of electrical energy</li> <li>• Constructional features and working principle of single phase and three phase induction type energy meter.</li> <li>• Different types of errors and their compensations.</li> <li>• Calibration of single phase induction type energy meter by direct loading.</li> <li>• Digital Energy meter: Working principle, advantages over analog meter</li> </ul>	05	10
<p><b>Topic 5: Measurement of Circuit Parameters.</b></p> <ul style="list-style-type: none"> <li>➤ Measure different resistances by selecting correct method of measurement.</li> <li>➤ Use LCR meter for measurement of L, C and R.</li> <li>➤ Classify the resistance</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Classification of resistance.-Low, Medium and High.</li> <li>• Methods of measurement of low and medium resistance by simple V-I method and by using digital multimeter.</li> <li>• Constructional features working principles and applications of megger and earth tester.</li> <li>• Comparison and applications of –analog and digital multimeter.</li> <li>• Working of L-C-R meter for measurement of inductance and capacitance</li> </ul>	07	14
<p><b>Topic 6: Constructional features, working principles and applications of Other meters.</b></p> <p><b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Select a meter for measuring P.F, Frequency and Phase sequence</li> <li>➤ Use Clip On Meter efficiently</li> <li>➤ Use of C.R.O. and function generator</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Single phase and three phase power factor meter.(Only dynamometer type)</li> <li>• Frequency meter- Reed type, Ferro-dynamic type, Weston type</li> <li>• Phase sequence indicator(Rotating type only)</li> <li>• Clip on ammeter.</li> </ul>	07	14

<ul style="list-style-type: none"> <li>• Synchroscope- Weston type only</li> <li>• C.R.O.- Block diagram, function of each block, front panel diagram, application, observation of waveform, Digital storage Oscilloscope (Block Diagram only)</li> <li>• Function generator- Block diagram, function of each block, front panel diagram, application of function generator in measurement. Block diagram of Sine wave generator.</li> </ul>		
<b>Total</b>	<b>48</b>	<b>100</b>

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

1. Apply different Measuring skill.
2. Select proper equipment.

**Motor Skills:**

1. Measurement of electrical quantities
2. Connections skill.
3. Handling of meters

**List of Practical's:**

1. To know measuring instruments on the basis of symbols on dial like, type, class position and scale.
2. To identify the components of PMMC and MI instruments, using working models.
3. To extend range of voltmeter and ammeter by using PT and CT.
4. To measure power in a single phase circuit by electro-dynamic watt-meter.
5. To measure active and reactive power of three phase balanced load using single wattmeter.
6. To measure active power of three-phase balanced load using two watt-meters.
7. To calibrate single phase energy meter by direct loading.
8. To use digital multi-meter and clamp on meter for measurement of AC/DC current, AC/DC voltage and resistance.
9. To use megger for various measurements.
10. To measure supply frequency and power factor in single-phase circuit.

**Learning Resources:****1. Books:**

<b>Sr. No.</b>	<b>Name of the Author</b>	<b>Title of the Book</b>	<b>Name of the Publisher</b>
1.	A.K.Sawhney	Electrical & Electronics Measurements & Instrumentation	Dhanpatrai & sons
2.	N.V. Suryanarayna	Electrical Measurements & Measuring Instruments	S, Chand & co.
3.	C.T. Baldwin	Fundamentals of Electrical Measurements	--
4.	R.K. Rajput	Electrical Measurements & Measuring Instruments	S. Chand & co.

**2. ISO, IS, BS standards, Data Sheets, IE Rules Handbook**

ISO: 1248, 1765, 6236, 9223, 8945, 2442

**3. Websites**[www.test-meter.co.uk/](http://www.test-meter.co.uk/)[en.wikipedia.org/wiki/Emerson\\_Electric\\_Company](http://en.wikipedia.org/wiki/Emerson_Electric_Company)[www.electrical-installation.org](http://www.electrical-installation.org)[www.idemi.org/](http://www.idemi.org/)[www.davis.com/](http://www.davis.com/)[www.sensors-research.com/links.htm](http://www.sensors-research.com/links.htm)



**Course Name : Diploma in Electrical Engineering****Course Code : EC / EG****Semester : Fifth****Subject Title : Transmission & Distribution of Electrical Power****Subject Code : 17968****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:**

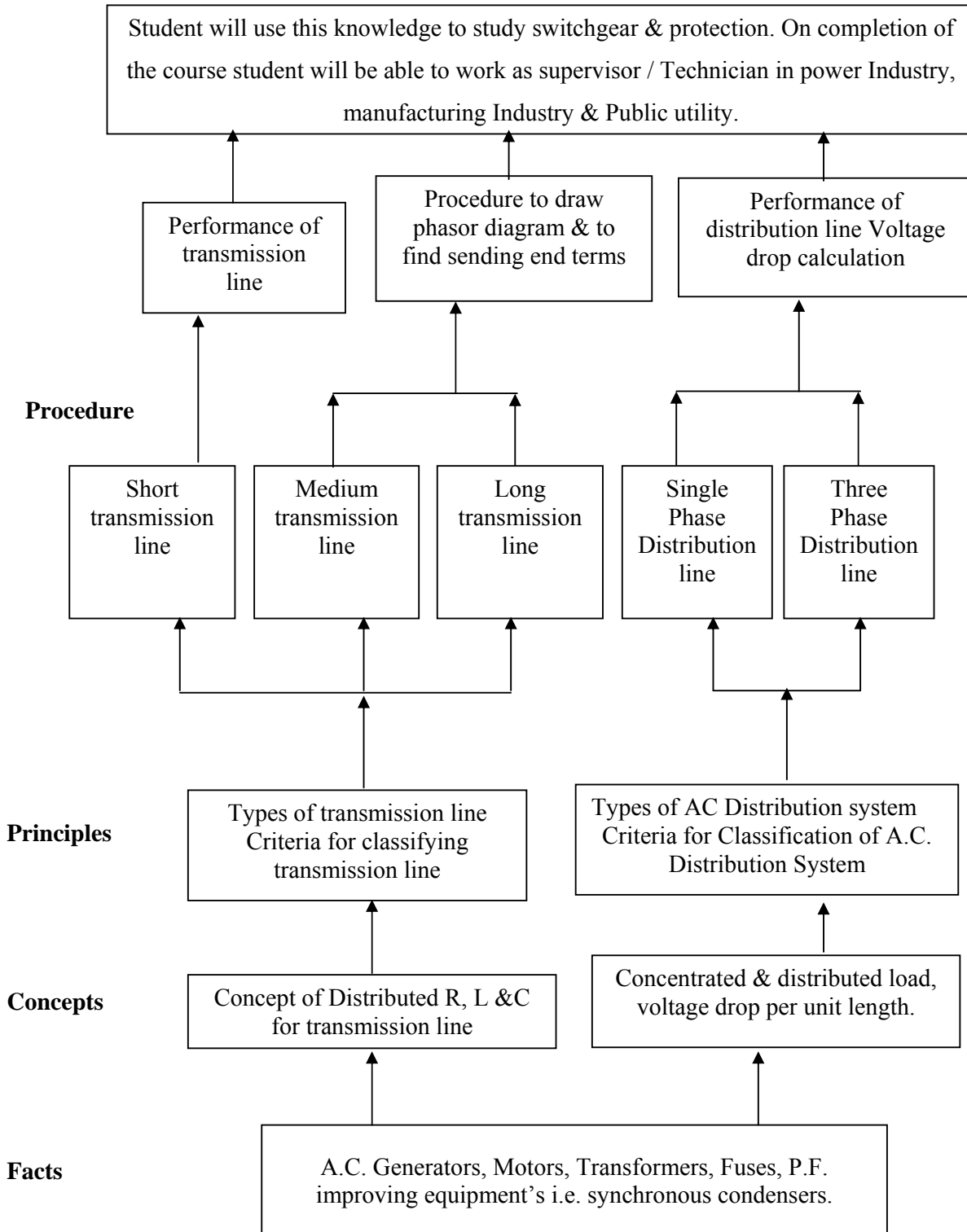
Electrical Diploma Engineers should know Transmission Voltages, Distribution Voltage. They should be able to identify various components & their functions. They will be able to measure system performance. They will use this knowledge in studying Switchgear & Protection on completing the study of Generation, Transmission, Distribution, Switchgear, Protection & utilization of electrical energy, Students will be work as electrical engineer in power industry.

**General Objectives: Student will be able to: -**

1. Know various types of Transmission & distribution system.
2. Identify various components & know their functions.
3. Know types of conductors used in transmission and distribution circuits
4. Know the effect of changes in parameters on performance of the lines
5. Draw substation layout as per the requirements.

**Learning Structure:**

**Applications**



**Theory:**

Topic and Contents	Hours	Marks
<p><b>Topic 1: Basic Transmission</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Draw single line diagram of a given transmission network</li> <li>➤ Classify the lines based on their length, voltage rating</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Single Line Diagram of Transmission &amp; Distribution of Electric supply system.</li> <li>• Meaning of Primary &amp; Secondary Transmission and its Standard Voltage level used in India.</li> <li>• Classification of Transmission Lines according to voltage level, Length of Transmission line, Type of Supply Voltage &amp; Method of Construction.</li> <li>• Advantage of High Voltage for power transmission</li> </ul>	04	08
<p><b>Topics 2: Transmission Line Components</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Identify the main Components of Transmission &amp; Distribution Line.</li> <li>➤ Select size and type of conductor for transmission line based on its rating</li> <li>➤ Calculate string efficiency</li> </ul> <p><b>Contents:</b></p> <p><b>Overhead Conductors: ----- 04 marks</b></p> <ul style="list-style-type: none"> <li>• Properties of Conducting Material.</li> <li>• Comparison of Copper &amp; Aluminum as a Conducting Material.</li> <li>• Different types of Conductor such as Copper, All Aluminium Conductor (AAC), Alluminium Conductor Steel Reinforced (ACSR), All Aluminium Alloy Conductor (AAAC), Bundled Conductor, Steel Conductor and their applications.</li> <li>• Trade Names of various types of conductors.</li> <li>• Stranded Conductor: Advantages &amp; Disadvantages.</li> </ul> <p><b>Underground Cables: ----- 04 Marks</b></p> <ul style="list-style-type: none"> <li>• Introduction &amp; requirements.</li> <li>• Classification of cables.</li> <li>• Cable conductors.</li> <li>• Cable construction.</li> <li>• Cable insulation, Metallic sheathing &amp; mechanical protection.</li> <li>• Comparison with overhead lines</li> <li>• Cable laying and Cable Joining</li> </ul> <p><b>Line supports: ----- 06 marks</b></p> <ul style="list-style-type: none"> <li>• Requirements of Supporting Structures</li> <li>• Types of Supporting Structure:</li> <li>• Poles: RCC Pole, RSJ (Rail Pole), Steel Tubular Pole their specification, method of erection and their comparison based of Cost, Life, Tensile strength, Insulating properties, maintenance, Weight, transportation and handling.</li> <li>• Steel Tower: Specifications, Material used, single circuit, double</li> </ul>	14	24

<p>circuit, Voltage levels.</p> <ul style="list-style-type: none"> <li>Advantages, Disadvantages &amp; Application of Steel Tower.</li> </ul> <p><b>Line Insulators : ----- 10 marks</b></p> <ul style="list-style-type: none"> <li>Electrical, Mechanical, Chemical, Thermal &amp; General Properties of Insulating Material.</li> <li>Selection of material for line insulators, standard dielectric strengths of insulating materials used.</li> <li>Types of Insulators used in Transmission and Distribution: Pin type, Suspension type, Strain type, Shackle type, Stay Insulator and their Applications.</li> <li>Causes of Insulator failure.</li> <li>String Insulator: Constructional features and applications.</li> <li>Self Capacitance, Shunt Capacitance &amp; Factor 'K' or 'M', Effect of factor 'K': Definition and effect on voltage distribution in the units of the string.</li> <li>Distribution of Potential over a string of Three Suspension Insulator.</li> <li>Define String Efficiency and develop its Mathematical Expression (Simple Numericals)</li> <li>Methods of Improving String efficiency.</li> </ul>		
<p><b>Topics 3: Transmission Line Parameters</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>Use appropriate method for reducing skin effect</li> <li>Prepare schedule for transposition of line</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>Concept of R, L &amp; C of Transmission Line, State their Effect on performance of Transmission line ( No Derivation &amp; Numericals)</li> <li>Skin Effect: Meaning of the term, its dependence on conductor size and configuration and material, Methods used to reduce the skin effect.</li> <li>Proximity Effect: Meaning of the term, its effect on performance of line, methods of reducing the effect.</li> <li>Ferranti Effect</li> <li>Phenomenon of Corona, Disruptive Critical Voltage and Visual Critical Voltage, Conditions affecting Corona, Power loss due to Corona, Methods of reducing Corona, Advantages &amp; Disadvantages of Corona.</li> <li>Concept of Transposition of Conductors and its necessity.</li> </ul>	08	12
<p><b>Topics 4: Performance of Transmission Line</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>Determine performance of the line based on efficiency and regulation</li> <li>Representation of line based on A, B, C ,D constants</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>Classification of Transmission line according to distance such as Short, Medium &amp; long Transmission Line.</li> <li>Definition of efficiency &amp; Regulation of Transmission line.</li> <li>Effect of Power Factor on Transmission efficiency and Regulation, Draw Vector diagram for Lag, Lead &amp; Unity Power factor.</li> <li>Derivation of Regulation Short Transmission line.</li> <li>Numericals on 1-phase &amp; 3-phase Short Transmission line:</li> </ul>	10	20

<p>Calculate Efficiency &amp; Percentage Regulation.</p> <ul style="list-style-type: none"> <li>• Analysis of Short transmission line: Equivalent Circuit &amp; Vector Diagram (No Mathematical Treatment)</li> <li>• Analysis of Medium transmission line: Equivalent Circuit with Nominal 'T', Nominal '<math>\pi</math>', and End Condenser Method, its Phasor diagram (No Mathematical Treatment)</li> <li>• Concept and Basic Equations of generalized circuit constants 'A', 'B', 'C', 'D' (No Derivation and Numericals)</li> </ul>		
<p><b>Topics 5: Extra High Voltage Transmission</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Understand the concept of HV Transmission</li> <li>➤ Know the use of HV Lines for Transmission and National Grid</li> <li>➤ Compare EHV A.C and HV D.C lines for performance</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Definition of EHV line, Its necessity and Importance.</li> <li>• Advantages, Limitations and Applications of Extra High Voltage AC (EHVAC) Transmission Line.</li> <li>• Advantages, Limitation &amp; Application of High Voltage DC (HVDC) Transmission Line.</li> <li>• Layout of HVDC Transmission Line: Monopolar, Bi-Polar &amp; Homopolar</li> <li>• HVDC Transmission Line Routes in India,</li> <li>• Comparison of EHVAC &amp; HVDC Transmission line.</li> </ul>	06	08
<p><b>Topics 6: A.C Distribution System</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Decide type of distributor to be used based on requirements</li> <li>➤ Determine performance of Distributer with given parameters</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Components of Distribution System.</li> <li>• Classification of distribution System</li> <li>• Requirements of an ideal Distribution System.</li> <li>• Meaning of Primary &amp; Secondary Distribution System with their voltage level and Number of conductors.</li> <li>• Comparison between Feeder &amp; Distributor.</li> <li>• Factors to be considered while designing Feeder &amp; Distributor.</li> <li>• Types of different distribution Scheme such as Radial, Ring, and Grid. Layout, Advantages, Disadvantages &amp; Applications.</li> <li>• Numericals on 1-phase A.C Distribution System to Calculate Voltage drop &amp; Voltage at sending end / Receiving end with Power factor referred to Voltage at receiving end.</li> </ul>	12	16
<p><b>Topics 7: Primary and Secondary Distribution Sub-Station</b> Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Identify components of sub stations with their ratings</li> <li>➤ Identify components from single line diagram</li> </ul> <p><b>Contents:</b></p> <ul style="list-style-type: none"> <li>• Definition and Classification of Sub-Station according to Nature of duty, Application (Service), Construction</li> <li>• Site Selection for Sub-Station.</li> <li>• Advantages, Disadvantages &amp; Applications of Indoor &amp; Outdoor Sub-Station.</li> </ul>	10	12

<ul style="list-style-type: none"> <li>• Single Line diagram (layout of ) 33/11KV Sub-Station.</li> <li>• Single Line diagram (layout of) 11KV/400V Distribution Transformer.</li> <li>• Symbols &amp; Functions of components of 33/11KV Sub-Station: Incoming Feeder, Busbar, Power Transformer, Lightning Arrester, Earth Switch Insulator (No Load Switch), Circuit Breaker, Horn Gap Fuse, Instrumental Transformer (CT &amp; PT), Control Panel, Control Room and Outgoing Line,</li> <li>• Symbols &amp; Functions of 11KV/400V Distribution Transformer Sub-Station: Functions of Incoming line, AB Switch, Drop down Fuse, Distribution Transformer, Cross Bracing, Anti climbing device, Danger board, Sub Station Earthing and Distribution box.</li> </ul>		
<b>Total</b>	<b>64</b>	<b>100</b>

**NOTES:**

1. Visit to 33 / 11 KV Substation.
2. Visit to 11KV/400V Distribution Substation in Campus.
3. Observe Samples of ACSR Conductors and Insulators.  
These visits may be arranged under Professional Practice.

**Learning Resources:****1. Books:**

Sr. No.	Author	Title	Publisher
1.	V.K.Mehta	Principles of Power System	S.Chand
2.	V. Kamraju	Electrical Power Distribution System	Mc.GrawHill
3.	S.Sivanagaraju S.Satyanarayana	Electrical Power Transmission and Distribution	Pearson
4.	Soni,Gupta, Bhatnagar	A Course in Electrical Power	Dhanpat Rai
5.	S.L.Uppal	A Course in Electrical Power	S.K.Khanna
6.	J.B.Gupta	Transmission and Distribution of Electrical Energy	S.K.Khanna

**2. IS, BIS and International Codes:**

1. IS 2713 (Part I, II, III) – 1980 for Specifications of Tubular Steel poles for Over Head Power Lines.
2. Standard Clearances as per BS: 162-1961 and BS: 159-1957
3. IS 398-1961 – Technical data of AAC and ACSR Conductors.
4. IS 398 (Part -4)-1994 - Technical data of AAAC

**3. Websites:**

1. Sonaversity \_ org
2. [www.animations.physics.unsw.edu.au](http://www.animations.physics.unsw.edu.au)
3. phy-clips

**Course Name : Diploma in Electrical Engineering****Course Code : EC / EG****Semester : Fifth****Subject Title : D. C. Machines and Transformers****Subject Code : 17969****Teaching and Examination Scheme:**

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

**NOTE:**

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

**Rationale:**

This subject is intended to teach the student facts, concepts, principles and procedures for the operations, testing and maintenance of electric machines such as dc motors, generators and transformers. Students will also be able to analyze characteristics of electric machines and transformers.

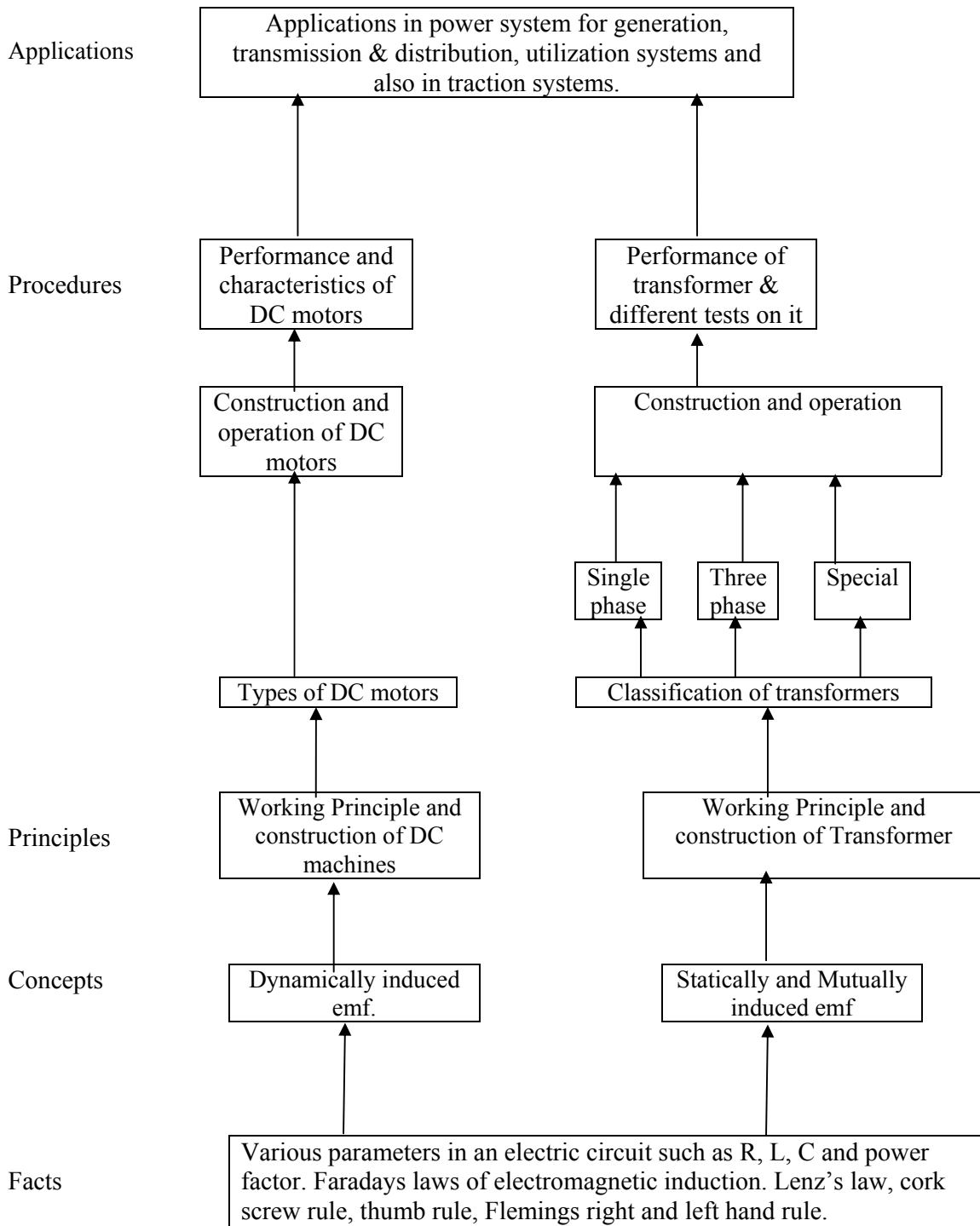
These machines are used in power system for generation, transmission & distribution, utilization systems and also in traction systems. Knowledge gained by the students will be used in the study of technological subjects such as power system operation & control, utilization system, switchgear & protection, testing and maintenance of electrical equipment and modern electric traction.

The students will be able to know the use of transformer in measurement, use of CT's and PT's in control circuits, fault locations etc. The knowledge and skill gained by the student will be used while working as technicians in discharging technical functions such as electrical supervisor, testing engineer and procurement engineer.

**General Objectives:****Students will be able to-**

1. Understand the laws governing the operation of electrical machines.
2. Understand the working principles of different DC machines and transformer.
3. Know the constructional details of the DC machines and transformer.
4. Know the areas of application of the various dc machines and different types of transformers.

**Learning Structure:**





**Theory:**

Topic and Contents	Hours	Marks
<p><b>Topic 1: DC Generators</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Identify the different parts of DC Machines.</li> <li>➤ Identify different types of DC generators from connection diagram.</li> </ul> <p><b>Contents:</b></p> <p>1.1 Introduction</p> <ul style="list-style-type: none"> <li>• Principle of operation of DC generator</li> <li>• Fleming's right hand rule</li> </ul> <p>1.2 Construction of DC machine</p> <ul style="list-style-type: none"> <li>• Parts and functions</li> <li>• Different materials used for different parts.</li> </ul> <p>1.3 E.m.f. equation of generator (derivation)</p> <ul style="list-style-type: none"> <li>• Numericals on e.m.f. equation</li> </ul> <p>1.4 Types of DC generators</p> <ul style="list-style-type: none"> <li>• Connection diagrams of different types of DC generators</li> <li>• Applications of DC generators</li> </ul>	06	08
<p><b>Topics 2: DC Motors</b>  <b>Specific Objectives:</b></p> <ul style="list-style-type: none"> <li>➤ Plot different characteristics of DC motors.</li> <li>➤ Control the speed of DC motors.</li> <li>➤ Determine the efficiency of DC motor.</li> <li>➤ Select DC motor for particular industrial applications.</li> </ul> <p><b>Contents:</b></p> <p>2.1 Introduction</p> <ul style="list-style-type: none"> <li>• Principle of operation of DC motor</li> <li>• Fleming's left hand rule</li> <li>• Back e.m.f. and its significance</li> <li>• Voltage equation and power equation of DC motor</li> <li>• Types of DC motors</li> </ul> <p>2.2 DC Motor Torque and Speed</p> <ul style="list-style-type: none"> <li>• Armature torque (derivation)</li> <li>• Shaft torque</li> <li>• Brake horse power</li> <li>• Numericals on torque and speed.</li> </ul> <p>2.3 Efficiency of DC Motor</p> <ul style="list-style-type: none"> <li>• Losses in DC motor</li> <li>• Power stages</li> <li>• Efficiency of DC motor</li> <li>• Condition for maximum efficiency</li> <li>• Numericals on efficiency.</li> </ul> <p>2.4 DC motor characteristics</p> <ul style="list-style-type: none"> <li>• Torque verses armature current</li> <li>• Speed verses armature current</li> <li>• Speed verses torque</li> <li>• Selection of motors for particular applications.</li> </ul> <p>2.5 Speed control of DC series motor</p> <ul style="list-style-type: none"> <li>• Flux control method</li> </ul>	12	18

<ul style="list-style-type: none"> <li>• Armature resistance control method (No numerical)</li> </ul> <p>2.6 DC motor starters</p> <ul style="list-style-type: none"> <li>• Necessity of DC motor starters</li> </ul> <p>2.7 Brushless DC Motor</p> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• Working</li> <li>• Applications</li> </ul>		
<p><b>Topic 3: Single Phase Transformer.</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ Draw phasor diagram of transformer for different load conditions.</li> <li>➤ Perform various tests on transformers</li> <li>➤ Evaluate parameters of transformer under different loading conditions.</li> <li>➤ Determine regulation and efficiency of single-phase transformer.</li> </ul> <p>Contents:</p> <p>3.1 Introduction</p> <ul style="list-style-type: none"> <li>• Principle of operation</li> <li>• Faradays law of electromagnetic induction.</li> </ul> <p>3.2 Construction of single phase transformer.</p> <ul style="list-style-type: none"> <li>• Magnetic circuit</li> <li>• Electric circuit</li> <li>• Dielectric circuit</li> </ul> <p>3.3 Types of transformers</p> <ul style="list-style-type: none"> <li>• Shell type and core type- their comparison</li> <li>• Step up and step down transformer</li> <li>• Amorphous Core type Distribution Transformer</li> </ul> <p>3.4 EMF equation of transformer</p> <ul style="list-style-type: none"> <li>• Derivation</li> <li>• Voltage transformation ratio</li> <li>• Numericals on above.</li> </ul> <p>3.5 Ideal transformer</p> <ul style="list-style-type: none"> <li>• Characteristics of ideal transformer.</li> <li>• Phasor diagram</li> </ul> <p>3.6 Practical Transformer</p> <ul style="list-style-type: none"> <li>• Transformer on no load-phasor diagram</li> <li>• Leakage reactance</li> <li>• Transformer on load- phasor diagram</li> <li>• Numericals on above.</li> </ul> <p>3.7 Equivalent circuit of transformer</p> <ul style="list-style-type: none"> <li>• Equivalent resistance and reactance</li> <li>• Numericals on above.</li> </ul> <p>3.8 Voltage regulation and Efficiency of transformer</p> <ul style="list-style-type: none"> <li>• Why transformer rating is in KVA?</li> <li>• Voltage regulation of transformer</li> <li>• Losses in transformer</li> <li>• Efficiency of transformer</li> <li>• Condition for maximum efficiency</li> <li>• All day efficiency</li> <li>• Numericals on above.</li> </ul> <p>3.9 Tests on Single phase Transformer</p> <ul style="list-style-type: none"> <li>• Polarity test</li> </ul>	26	42

<ul style="list-style-type: none"> <li>• Direct loading test</li> <li>• Open circuit test</li> <li>• Short circuit test</li> <li>• Voltage regulation and efficiency based on OC &amp; SC tests.</li> <li>• Numericals on above.</li> </ul> <p>3.10 Parallel operation of transformer</p> <ul style="list-style-type: none"> <li>• Advantages of parallel operation of transformer.</li> <li>• Conditions for parallel operation of transformer.</li> <li>• Load sharing with equal turn ratio</li> <li>• Concept of load sharing with unequal turn ratio</li> <li>• Numericals on above.</li> </ul>		
<p><b>Topic 4: Three Phase Transformer.</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ To identify different parts of three-phase transformer.</li> <li>➤ To identify polarity and phases of three-phase transformer.</li> <li>➤ To select three-phase transformer for particular applications.</li> </ul> <p>Contents:</p> <p>4.1 Introduction</p> <ul style="list-style-type: none"> <li>• Bank of three single phase transformer</li> <li>• Single unit of three phase transformer</li> <li>• Construction, different parts and their functions</li> <li>• Types of transformer cooling</li> <li>• Three phase transformers connections as per IS:2026 (part IV)-1977</li> <li>• Three phase to two phase conversion (Scott Connection)</li> <li>• Comparison between Distribution transformer and Power transformer</li> </ul> <p>4.2 Selection of transformer as per IS: 10028 (Part I)-1985</p> <ul style="list-style-type: none"> <li>• Criteria for selection of distribution transformer</li> <li>• Criteria for selection of power transformer</li> </ul> <p>4.3 Parallel operation of three phase transformer</p> <ul style="list-style-type: none"> <li>• Conditions for parallel operation</li> </ul> <p>4.4 Specification of three-phase distribution transformer as per IS:1180 (part I)-1989</p> <p>4.5 Tests on Three-phase Transformer</p> <ul style="list-style-type: none"> <li>• Polarity test</li> <li>• Phasing out test</li> </ul> <p>4.6 Three- phase auto transformer</p> <ul style="list-style-type: none"> <li>• Construction</li> <li>• Operation</li> <li>• Application</li> </ul>	12	16
<p><b>Topic 5: Special Transformers.</b></p> <p>Specific Objectives:</p> <ul style="list-style-type: none"> <li>➤ To use various special transformers for particular applications..</li> </ul> <p>Contents:</p> <p>5.1 Single phase auto transformer</p> <ul style="list-style-type: none"> <li>• Construction and working</li> <li>• Comparison with two winding transformer</li> <li>• Advantages and disadvantages of auto transformer</li> </ul>	08	16

5.2	<ul style="list-style-type: none"> <li>• Applications of auto transformer</li> <li>• Instrument Transformers</li> <li>• Current transformer- construction, working and applications</li> <li>• Potential transformer- construction, working and applications</li> </ul>		
5.3	<ul style="list-style-type: none"> <li>• Isolation transformer</li> <li>• Features and applications</li> </ul>		
5.4	<ul style="list-style-type: none"> <li>• Single phase welding transformer</li> <li>• Features and applications.</li> </ul>		
<b>Total</b>		<b>64</b>	<b>100</b>

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

1. To understand the concepts of DC machines and transformers.
2. To identify different parts and windings of DC machines and transformers.
3. Ability to test, plot and verify the characteristics.
4. Ability to interpret the test results.

**Motor Skills:**

1. To draw the circuit diagram.
2. To measure different parameters using different meters.
3. To connect different meters according to circuit diagram.
4. To follow sequence of operations.
5. To measure the values and note down the readings.
6. To operate DC machines and transformers.

**List of Practicals:**

1. Observe and identify different constructional parts of D. C machine and identify different windings by resistance measurement.
2. Start a D. C shunt motor and reverse its direction of rotation.
3. Control the speed of D.C series motor by flux control and armature resistance control.
4. Perform load test on D. C series motor and plot its performance characteristics.
5. Perform brake test on D. C shunt motor and plot speed – Torque characteristics.
6. Determine transformation ratio, regulation and efficiency of single phase transformer by direct loading.
7. Perform open circuit and short circuit test on single phase transformer and determine equivalent circuit constants, regulation and efficiency.
8. Perform parallel operation of single phase transformer and determine the load sharing.
9. Visit a transformer manufacturing unit /repairing workshop and observe the constructional details of a three phase distribution transformer and identify various parts.
10. Perform polarity test and phasing out test on a three phase transformer.

**Learning Resources:****1. Books:**

Sr. No.	Author	Title	Publisher
1.	V. N. Mittle & Arvind Mittal	Basic Electrical Engineering	Tata McGraw Hill Education Pvt. Ltd. New Delhi
2.	D. P. Kothari &	Electrical Machines	Tata McGraw Hill Education Pvt.

	I. J.Nagrath		Ltd. New Delhi
3.	S. K. Bhattacharya	Electrical Machines	Tata McGraw Hill Education Pvt. Ltd. New Delhi
4.	V. K. Mehta & Rohit Mehta,	Principles of Electrical Machines	S.Chand and Co.Ltd., New Delhi
5.	K. Murungesh Kumar	DC Machines and Transformers	Vikas Publishing House Pvt. Ltd. New Delhi.
6.	Tarnekar & Kharabanda.	Laboratory Course in Electrical Engineering	S.Chand and Co.Ltd., New Delhi
7	B. L. Theraja	Electrical Technology	S.Chand and Co.Ltd., New Delhi
8	Edward Hughes	Electrical and Electronics Technology	ELBS Publication.
9	M. N. Bandyopadhyay	Electrical Machines theory and practice	PHI Learning Pvt. Ltd., New Delhi

## 2. CDs, PPTs, Models, Charts etc.:

### Videos-

1. <http://www.youtube.com/watch?v=RAc1RYilugI>
2. <http://www.youtube.com/watch?v=Ue6S8L4On-Y&feature=related>
3. [http://www.youtube.com/watch?v=d\\_aTC0iKO68&feature=related](http://www.youtube.com/watch?v=d_aTC0iKO68&feature=related)
4. <http://www.youtube.com/watch?v=Xi7o8cMPI0E&feature=related>
5. <http://www.youtube.com/watch?v=VucsoEhB0NA&feature=related>
6. [http://www.youtube.com/watch?v=A951LRFRL\\_M&feature=related](http://www.youtube.com/watch?v=A951LRFRL_M&feature=related)

## 3. IS, BIS and International Codes:

- IS: 2026 (Part IV)-1977 Indian standard specification for power transformers PART IV Terminal markings, tappings and connections
- IS: 10028 (Part I )-1981 Indian standard code of practice for selection, installation and maintenance of transformers, PART I selection
- IS: 1180 (Part I)-1977 Indian standard specification for power transformer

## 4. Websites:

- [www.standardsbis.in/](http://www.standardsbis.in/)
- [www.bis.org.in/](http://www.bis.org.in/)
- [www.youtube.com/watch](http://www.youtube.com/watch)
- [www.google.co.in](http://www.google.co.in)

**Course Name : Diploma in Electrical Engineering****Course Code : EC / EG****Semester : Fifth****Subject Title : Computer Programming****Subject Code : 17970****Teaching and Examination Scheme**

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

**Rationale:**

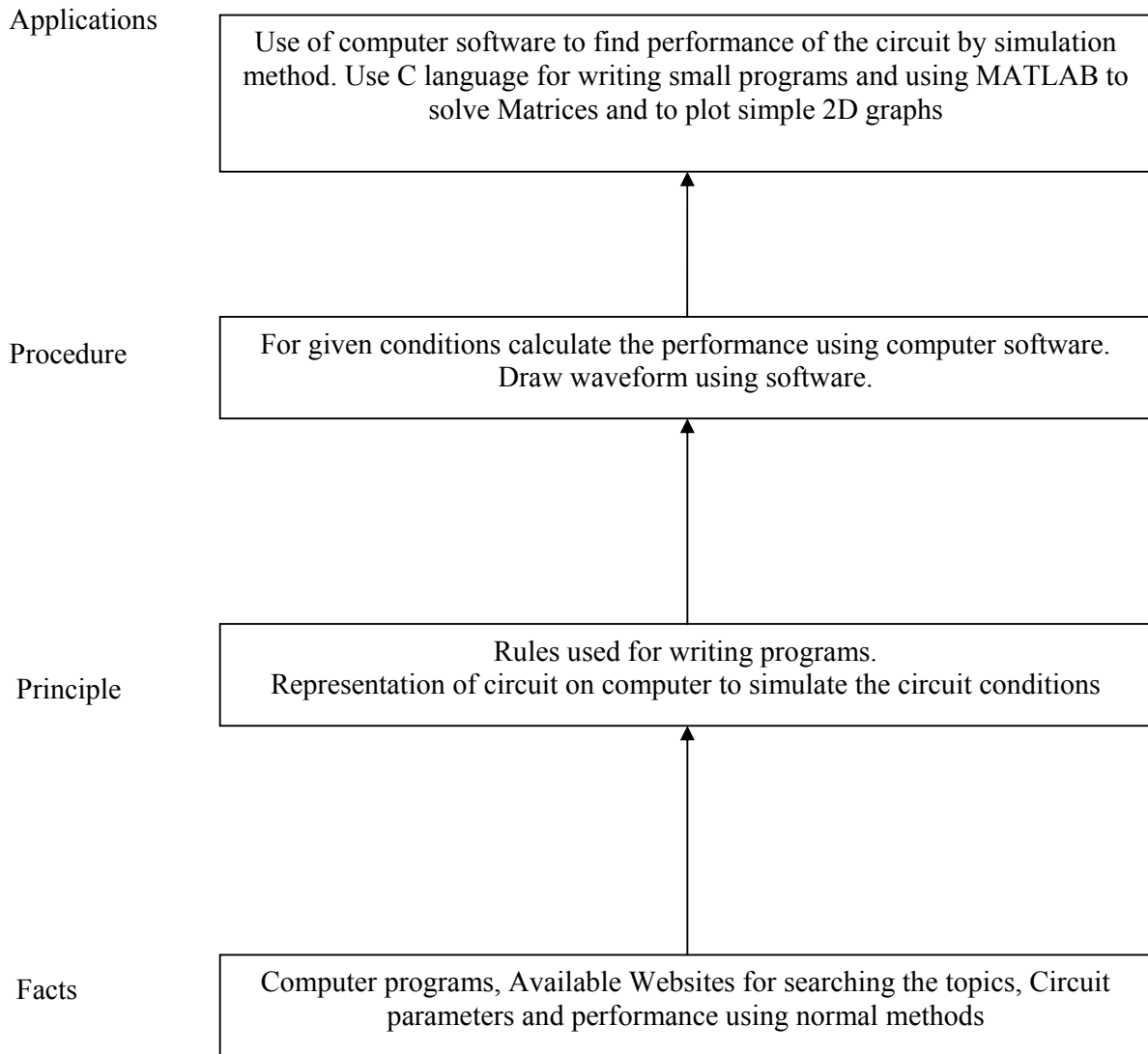
For any engineering, computer software skills are mandatory. Computer has become important part of any learning process. Therefore, it is necessary for any engineering student to have basic idea about computer languages. 'C' is most widely used general purpose powerful, efficient and compact language. This subject covers C as a basic logic development language.

MATLAB is said to be the language of engineers. It is widely used in mathematics, science and engineering. The MATLAB is used in this subject to solve common mathematical problems and to write simple program to plot simple graph.

**General Objectives:**

1. Describe concepts, variables and constants.
2. Write simple input/output program.
3. Write simple programs related to condition handling.
4. Write a program related to looping.
5. Understand concept of function.
6. MATLAB as a mathematical problem solving tool.
7. To draw 2 D plots using MATLAB.

**Learning Structure:**



**Theory:****Note: Theory to be completed in the allotted practical hours.**

<b>Topic and Contents</b>
<p><b>Topic 1: Basics of C</b></p> <ul style="list-style-type: none"> <li>➤ History of C.</li> <li>➤ C character set, tokens, variable, constant, keywords, data types</li> <li>➤ Operators (Arithmetic, Relational, Logical).</li> <li>➤ Formatted input, output statement (printf, scanf).</li> </ul>
<p><b>Topic 2: Decision Making</b></p> <ul style="list-style-type: none"> <li>➤ Decision making using If-Else statement, switch case statement,.</li> <li>➤ Decision making using loop statements like while, do-while, for.</li> </ul>
<p><b>Topic 3: Arrays</b></p> <ul style="list-style-type: none"> <li>➤ Declaring one dimensional array, simple programs on arrays such as largest of array, sorting array.</li> </ul>
<p><b>Topic 4: Functions</b></p> <ul style="list-style-type: none"> <li>➤ Necessity of functions, defining user defined functions, calling functions, call by value, call by reference</li> </ul>
<p><b>Topic 5: MATLAB Environment</b></p> <ul style="list-style-type: none"> <li>➤ Command window, Command history, Workspace, Edit window, Help window</li> <li>➤ Elementary built in functions.</li> </ul>
<p><b>Topic 6 Matrices in MATLAB:</b></p> <ul style="list-style-type: none"> <li>➤ Entering data in Matrices ,Matrix Subscripts /Indices, Some useful commands related to Matrices such as det, rank, trace, inv, norm, transpose, zeros, ones, eye, arithmetic operations on matrices ,arrays, Relational operators</li> </ul>
<p><b>Topic 7 Programming in MATLAB &amp; Graphics</b></p> <ul style="list-style-type: none"> <li>➤ MATLAB editor: Creating M Files Function subprograms</li> <li>➤ 2 D PLOTS : printing labels, grid and axes box, entering text in a plot , axis control</li> <li>➤ Multiple plots :using plot , hold ,line commands</li> <li>➤ Specialized 2 D plots using Polar, area, bar, hist, pie, stem function</li> </ul>
<p><b>Topic 8 Fundamentals of Simulink</b></p> <ul style="list-style-type: none"> <li>➤ Simulink Modelling : Collecting blocks to create a model , modifying block parameters, labeling blocks, commonly used blocks</li> </ul>



**Note:**

1. **Related theory as mentioned above will be taught while performing the respective practicals.**
2. **The term work will consist of print outs of programs developed by the students in the laboratory.**

**(The teacher shall ensure that each student actually performs the practical before taking the print outs.)**

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

1. To understand the output of a program.
2. To understand and use the conditions in a program.
3. To understand the idea of a loop
4. To read and initialize the array
5. To analyze the program

**Motor Skills:**

1. Ability to operate a keyboard and machine
2. Ability to edit and debug a program
3. Ability to compile and execute the program
4. Ability to write a programs using Library functions

**List of Practical:**

1. Write a program to display a number in decimal, octal and hexadecimal form by using different format specifics.
- 2A. Write a program to display largest of three integer numbers.
- 2B. Write a program to display remarks such as distinction, first class, second class, pass class and fail according to the marks.
4. Write a program for arithmetic operations such as addition, subtraction, multiplication and division of two numbers using switch case statement.
4. Write program to display reverse of a given number using for loop.
- 5A. Write a program to display multiplication table of a given number using do while loop.
- 5B. Write a program to display sum of first n numbers using while loop.
6. Write a program to accept one dimensional array and display the array in ascending order.
7. Write a program to swap two numbers using call by value, call by reference.
8. Understand commands in MATLAB. (General, Directory, Workspace, Termination, Help)
9. Use MATLAB to enter a data in matrix and practice the functions such as sum, mean, length, max and min.
10. Understand special matrix functions such as zeros, eye, ones, det, inv and find in MATLAB.

11. Write commands to create two matrices of 3 \* 3 size and perform addition, subtraction, multiplication, right division, left division using MATLAB.
11. Write a program in MATLAB to plot a curve given by equation  $y = \sin(x)$ ,  $y = \cos(x)$ ,  $y = x^2$  (Use hold command)
13. Write a program in MATLAB to illustrate the use of subplot command.
14. Create a Simulink model to verify Ohm's Law.

**Learning Resources:****1. Books:**

Sr. No.	Author	Title	Publisher
1	Balgurusamy	Programming in ANSI C	Tata McGraw Hill
2	Harshal Arolkar Sonal Jain	Simplyfying C	DreamTech
3	Kashi Nath Dey Samir Bandopadhyay	C programming Essentials	Pearson
4	Bansal Goel Sharma	MATLAB & its application in Engineering	Pearson
5	Agam Kumar Tyagi	MATLAB and Simulink	Oxford
6	K K Sharrna	MATLAB Demystified	Vikas
7	Amos Gilat	MATLAB an Introduction with application	Willey India Edition

**2. Websites:** [www.vikaspublishing.com/teachersmanual.aspx](http://www.vikaspublishing.com/teachersmanual.aspx)