

Maharashtra State Board of Vocational Examination, Mumbai 400 051.

1	Name of Course	Diploma Course In ELECTRICAL ENGINEERING									
2	Course Code	302405									
3	Max no. of Students	25									
4	Duration	2 year									
5	Course Type	Full Time									
6	No. of Days per week	6 days									
7	No. of hours per day	7 Hrs									
8	Space require	Theory Class Room – 200 sqft Three Practical Lab – 500 sqft each									
9	Entry qualification	S.S.C. Pass									
10	Objective of syllabus	<ul style="list-style-type: none">• To develop professional competence in the field of electrical.• To train the students to acquire skills and mastery in the use of electric circuits.• To train the students to repair or rewinding and test the different electrical equipment.• To prepare for self and wage employment.• To prepare competent electrical technicians for the small-scale industry.									
11	Employment opportunities	The students can get job in industries; with work experience he could start his own business.									
12	Teachers Qualification	1) For Vocational subject - B.E. in Electrical Engineering 2) For Non Vocational Subject - Master Degree in Concern subject									
13	Teaching Scheme –										
	Sr.	Subject	Subject Code	Clock Hours / Week					Total		
				Theory	Practical						
	1	English (Communication Skill)	90000001	2 Hrs	1 Hrs				3 Hrs		
	2	Elective – I		2 Hrs	1 Hrs				3 Hrs		
	3	Elective – II		2 Hrs	1 Hrs				3 Hrs		
	4	BASIC ELECTRICAL WORKSHOP PRACTICE	30240001	3 Hrs	8 Hrs				11 Hrs		
	5	FUNDAMENTALS OF ELECTRICAL ENGINEERING	30240002	3 Hrs	8 Hrs				11 Hrs		
	6	ELECTRICAL MACHINES	30240007	3 Hrs	8 Hrs				11 Hrs		
	Total									42 Hrs	
14	Internship	Two Month Summer Internship from 1 st May to 30 th June is Compulsory.									
15	Examination Scheme – Final Examination will be based on syllabus of both years.										
	Paper	Subject	Subject Code	Theory			Practical			Total	
				Duration	Max	Min	Duration	Max	Min	Max	Min
	1	English Communication skill)	90000001	3 Hrs	70	25	3 Hrs	30	15	100	40
	2	Elective – I		3 Hrs	70	25	3 Hrs	30	15	100	40
	3	Elective – II		3 Hrs	70	25	3 Hrs	30	15	100	40
	4	BASIC ELECTRICAL WORKSHOP PRACTICE	30240001	3 Hrs	100	35	3 Hrs	100	50	200	85
	5	FUNDAMENTALS OF ELECTRICAL ENGINEERING	30240002	3 Hrs	100	35	3 Hrs	100	50	200	85
	6	ELECTRICAL MACHINES	30240007	3 Hrs	100	35	3 Hrs	100	50	200	85
	Total									900	375
16	Teachers – Three Teachers per batch for vocational component. For English, Elective-I & II guest faculty on clock hour basis.										
17	a) For Elective I – Student can choose any one subject Code Subject Name 90000011 Applied Mathematics 90000012 Business Economics 90000013 Physical Biology (Botany & Zoology) 90000014 Entrepreneurship 90000015 Psychology b) For Elective II – Student can choose any one subject Code Subject Name 90000021 Applied Sciences (Physics & Chemistry) 90000022 Computer Application 90000023 Business Mathematics										

BASIC ELECTRICAL WORKSHOP PRACTICE – 1st year

(Subject Code – 30240001)

THEORY	PRACTICAL
1. Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard	Implementation in the shop floor of the various safety measures. Visit to the different sections of the Institute Demonstration on elementary first aid. Artificial Respiration
2. Identification of Trade-Hand tools-Specifications	Demonstration of Trade hand tools. Identification of simple types- screws, nuts & bolts, chassis, clamps, rivets etc. Use, care & maintenance of various hand tools.
3. Fundamental of electricity. Electron theory- free electron. Fundamental terms, definitions, units & effects of electric current	Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand. Demonstration & Practice on bare conductors joints--such as Britannia, straight , Tee, Western union joints
4. Solders, flux and soldering technique. Resistors types of resistors & properties of resistors	Practice in soldering- Measurement of Resistant and Measurement of specific Resistant. Application of Wheatstone bridge in measurement of Resistance
5. Common Electrical Accessories, their specifications-Explanation of switches lamp holders, plugs and sockets .Developments of domestic ckts, Alarm & switches, lamp, fan with individual switches, two way switches.	Practice on installation and overhauling common electrical accessories. Fixing of switches, holder plugs etc. in T.W. boards. -Identification and use of wiring accessories.
6. Marking use of chisels and hacksaw on flats, 7. Sheet metal filing practice, filing true to line.	Introduction of fitting trade. Safety precautions to be observed Description of files, hammers, chisels hacksaw frames & blades-their specification & grades. Care & maintenance of steel rule try square and files.
8. Sawing and planing practice. Practice in using firmer chisel and preparing simple half lap joint.	Marking tools description & use. Description of carpenter's common hand tools such as saws planes, chisels mallet claw hammer, marking, dividing & holding tools-their care and maintenance.

9. Drilling practice in hand drilling & power drilling machines. Grinding of drill bits.	Types of drills description & drilling machines, proper use, care and maintenance.
10. Practice in using taps & dies, threading hexagonal & square nuts etc. cutting external threads on stud and on pipes, riveting practice.	Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.
11. Practice in using snips, marking & cutting of straight & curved pieces in sheet metals. Bending the edges of sheets metals. Riveting practice in sheet metal. Practice in making different joints in sheet metal in soldering the joints.	Description of marking & cutting tools such as snubs shears punches & other tools like hammers, mallets etc. used by sheet metal workers. Types of soldering irons-their proper uses. Use of different bench tools used by sheet metal worker. Soldering materials, fluxes and process.
12. Definition of Engineering Drawing. Uses of Engineering Drawing.	Freehand sketching of straight lines, rectangles, squares, circle polygons etc.
13. Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.	Practice on Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.
14. Lettering	Lettering practice
15. Different types of line.	Drawing of different types of line
16. 1st angle projection, 3rd angle projection. Orthographic views, Isometric views.	Drawing of different blocks
17. Drawing of plan, elevation & side views from isometric views	Practice of different blocks

BASIC ELECTRICAL WORKSHOP PRACTICE – 2nd year

(Subject Code – 30240001)

THEORY	PRACTICAL
<p>1. Conducting Materials Copper and aluminium as low resistivity materials, their electrical characteristics</p> <p>2. And applications. Electric resistance materials. Materials for lamp filaments and</p> <p>3. Brushes. Tungsten, Nichrome, Eureka, Selenium and Carbon as high resistivity</p> <p>4. materials, their electrical characteristics and applications.</p>	
<p>5. Insulating Materials : Distinction between conductor, insulator and semi conductor, insulation resistance, dielectric strength, breakdown voltage, mechanical ; and physical properties and classification of insulating materials. Paper, plastic coated paper. Empire cloth Leatherwood Cotton and silk, Rubber, PVC Porcelain, Bitumen, Micro, Bakelite, Ebonite, Marble, Glass Asbestos, Fibre glass-their uses and applications insulating tapes, Sleeves, insulating and impregnating varnishes and paints-their uses and applications.</p>	
<p>6. Magnetic Materials : Classification of materials as Ferromagnetic materials, soft and hard magnetic material, Mild steel, silicon steel, Mu-metal, Perm alloy, Alnico as magnetic materials their properties and uses.</p>	
<p>7. Structure Materials : Iron Steel, Brass, Gun Metal and Aluminium as structural materials, their properties and applications.</p>	
<p>8. Semiconductor materials: Electric properties of semi-conducting elements and compounds and their application. Zone refining and crystal growth.</p>	
<p>9. Lubricants : Solid, semi-solid and liquid lubricants-uses and applications.</p>	

10. Importance of wire joints, mechanism of failure of joint, methods of minimizing joint failures. Importance of lugs in joints, bus bars, methods of reducing the contact/join resistance, How to join the dissimilar metal joints, Use of multimeter and meggar.	Making of different types of wire joints, fixing of lugs.
11. Two-dimensional geometrical construction – conic sections, involutes and cycloids – Representation of three-dimensional objects – principles of projections – standard codes of principles.	
12. Hardware – display technology – software – introduction to drafting software.	
13. Average and related shop problems. Work, Power & Energy – Their units and related problems.	Sums on related chapters

LIST OF MATERIALS (FOR 25 STUDENTS.)

Sr. No	Details of Materials	Quantity
1	Voltmeter a.c. 0—250v	4 No.
2	Voltmeter D.c. 0—250v	4 No.
3	Voltmeter a.c. 0—500v	4 No.
4	Voltmeter D.c. 0—30v	4 No.
5	Ammeter A.C. 0—1 Amp.	4 No.
6	Ammeter A.C. 0—10 Amp.	4 No.
7	Ammeter A.C. 0—5 Amp.	4 No.
8	Ammeter D.C. 0—1 Amp.	4 No.
9	Ammeter D.C. 0—5Amp.	4 No.
10	Speedometer	1 No.
11	Wattmeter 0—250W	1 No.
12	Wattmeter 0—500W	1 No.
13	Wattmeter 0—1500W	1 No.
14	Energy meter 5-15Amp.	1 No.
15	Power Factor meter	1 No.
16	Frequency meter	1 No.
17	Galvanometer	1 No.
18	Rheostat 50 ohm's	4 No.
19	Rheostat 450 ohm's	4 No.
20	Rheostat 1150 ohm's	4 No.
21	D.C. power supply 30V—1Amp.	1 No.
22	Tube fitting	4 No.
23	Ordinary iron	4 No.
24	Automatic iron	4 No.
25	Toaster	2 No.

26	Room heater Rod type	1 No.
27	Electric stove	1 No.
28	Hot plate	1 No.
29	Oven	1 No.
30	Cooking range	1 No.
31	Water heater Immersion type	1 No.
32	Water heater Instant type	1 No.
33	Water heater Storage type	1 No.
34	Bell	2 No.
35	Buzzer	2 No.
36	Emergency light	1 No.
37	Split phase motor	1 No.
38	Capacitor start induction motor	1 No.
39	Permanent capacitor motor	1 No.
40	Shaded pole motor	1 No.
41	Universal motor	1 No.
42	D.C. Series motor	1 No.
43	D.C. Shunt motor	1 No.
44	D.C. Compound motor	1 No.
45	Lead acid battery	1 No.
46	Three phase main switch 16 amp.	2 No.
47	Three phase main switch 32 amp.	2 No.
48	Three phase motor 1 HP	1 No.
49	Three phase motor 3HP	1 No.
50	Three point starter	1 No.
51	D. O.L. starter	1 No.
52	Star Delta starter Manually operated	1 No.
53	Star Delta starter Automatically	1 No.
54	Room Heater Blower type	1 No.
55	Hair Dryer	1 No.
56	Mixer	1 No.
57	Room Cooler	1 No.
58	Vacuum Cleaner	1 No.
59	Electric Hand Drill machine	1 No.
60	Voltage Stabilizer	1 No.
61	Inverter	1 No.
62	Work Bench	4
63	Bench vice	4
64	Pipe vice	1
65	Armature holder	2
66	Steel rules / Measuring Tape	2 each
67	Micrometer / Varnier calipers	2 each
68	S.W.G.	4
69	Filler gauge / Dial Gauge	4 each
70	Multi meter	4
71	Try square	4
72	Pipe cutter	1
73	Hacksaw with blade	6
74	Hand Drill machine	4
75	Chisel /files	4 each
76	Spanner Set (Double Ended ,Ring , Box)	1 each
77	Screw Driver / Pliers/ Tester /Wire stripper	20 each
78	Hammer /Mallet / Electrician knife	10 each
79	Pocker / Firmer chisel / Tennon saw	4 each
80	Tungstan wire /Nicrome wire	As required.

REFERENCE BOOKS

No	Name of the book	Author
1	Basic Electrical Engineering	M.L. Anwani
2	Study of Domestic Appliances	R.K. Bhatia
3	Electrical wiring Estimating and costing	S.L. Uppal
4	Electrical Appliances	I.M. Anwani
5	Basic Electrical Engineering vol- 1,2,3,4	P.P.Shah
6	Basic Electrical Engineering vol.1,2,3,4	B.L. Thareja
7	Electrical Machine	V.K.Mehata
8	Indian Electricity Rules	Nausheer Bharucha D.B. Taraporewala sons and co.
9	Vidyutshastra vol.1,2,3,4	P.P.Shah
10	Domesric Appliance XI and XII	Shri Bobade
11	Audel's Home Appliance servicing	Edwin P. Anderson
12	Small Appliance vol-2	Jack Darr
13	Small Home Appliance(Book II)	Jack Darr
14	How to repair major appliances	Ernest Tricomi
15	Basic Appliance Repair	Cliff Porter
16	Electrical Appliances: Installation and Maintenance (Second Edition)	E.Molloy
17	Basic Electronics	Berard Grob
18	Electrical Technology	H.Cotton
19	Elementary Electrical Engineering	M.L.Gupta

FUNDAMENTALS OF ELECTRICAL ENGINEERING – 1st year
(Subject Code – 30240002)

THEORY	PRACTICAL
<p>1. Introduction</p> <p>What are electricity and its sources? Definition of Resistance, Voltage, Current, Power, Energy and their units, Factors affecting resistance of a conductor.</p> <p>Temperature coefficient of resistance. Difference between ac and dc voltage.</p>	<p>1. Measurement of current, voltage and resistance of the help of millimetre.</p> <p>2. Verification of Ohm's Law.</p> <p>3. Measurement of equivalent resistance of series combination of resistors.</p>
<p>2. D.C. Circuits:</p> <p>Ohm's Law Relation between voltage and current in a dc circuit. Series and Parallel resistance circuits and their equivalent resistance. Series-Parallel</p> <p>Resistance circuits, calculation of equivalent resistance. Kerchief's laws and Their applications.</p>	<p>4. Measurement of equivalent resistance of parallel combination of resistors.</p> <p>5. Measurement of equivalent resistance of series-parallel components of resistors.</p> <p>6. To verify Kirchhoff's current laws.</p> <p>7. Charging a lead acid battery and to test its state of charge.</p>
<p>3. Batteries</p> <p>Primary cell, dry cell, battery, series and parallel connection of cells, Secondary cells, Lead Acid Cell, discharging and recharging of battery</p> <p>Common charging methods, care and maintenance of secondary Battery</p> <p>Sp [edifications of a cell Battery.</p>	<p>8. Study of series and parallel capacitor circuits.</p> <p>9. Study of series and parallel resistor circuits/lamps.</p> <p>10. Study of R.L. series circuit and measurement of impedance, power and power factor.</p> <p>11. Study of R.C. series circuit and measurement of impedance, power and power factor.</p>
<p>4. Heating and Lighting Effects of Current:</p> <p>Joule's Laws of electric heating and its domestic applications, heating efficiency</p> <p>Lighting effect of electric current, Filaments used in lamps, lamps and gas</p> <p>Discharge lamps, their specifications, working and applications.</p>	<p>12. Study of R.L.C. series circuit and measurement of impedance, power and power factor.</p> <p>13. Connections of Ammeter, Voltmeter and Wattmeter in an A.C. circuit of resistive load.</p>
<p>5. Capacitors:</p> <p>Capacitor units and capacity. Concept of charging and discharging of Capacitors. Types of capacitors and their use in circuits. Series and parallel</p> <p>Connection of capacitors Energy stored in a capacitance</p>	<p>14. To test a single phase energy meter with the help of standard wattmeter and stop watch with resistive load.</p> <p>15. Controlling low voltage lamps in series.</p> <p>16. Controlling lamps from two or three places.</p>
<p>6. Electromagnetic Effects:</p> <p>Permanent magnets and Electromagnets their construction and use.</p> <p>Paternities of an electromagnet and rules for finding them.</p>	<p>17. Drawing schematic diagram of single phase supply to consumers.</p> <p>18. Drawing schematic diagram of three phase supply to consumers.</p>

<p>Faraday's Laws of Electromagnetic Induction and applications. Dynamically induced e.g., its Magnitude and direction. Static e.g., its magnitude and direction. Static Induction, self induced e.g. its magnitude and direction. Inductance and its Unit. Mutually induced e.g. its magnitude and direction.</p>	<p>19. Practice on CTS/TRS (Batten) wiring with 2 fans, 4 lamps, 2 tubes and 4 plug points.</p> <p>20. Practice on conduit wiring.</p> <p>21. Polarity (means phase and neutral testing) test of wiring installation.</p> <p>22. Measurement of insulation resistance of wiring installation by megger.</p> <p>23. Testing of wiring installations with the help of megger.</p> <p>24. Installation of pipe earthing for wiring installation.</p> <p>25. Study of plate earthing for wiring installation.</p> <p>26. Testing faults of wiring installation and rectification.</p> <p>27. Installation of a sub-meter between a given electrical wiring.</p> <p>28. Measurement of open Circuit Voltage and short circuit current of a PV Module.</p> <p>29. To study/Install a Solar Street light System.</p>
<p>7. A.C. Circuits:</p> <p>Principles of Generation of A.C. voltage and wave shape Cycle, frequency, peak Value (maximum value) average value, instantaneous value, R.M.S. value Introduction to resistance, capacitance and induction. What is inductive? Reactive and capacitive reactance phase, phase difference, power factor (Leading and lagging). Impedance, impedance of R.L. & C, A.C Circuits with (i) Resistance and inductance, (ii) resistance and capacitance (iii) Resistance, Inductance and capacitance in series.</p>	
<p>8. Measuring instruments:</p> <p>Working principles of moving iron and moving coil voltmeters and ammeters, Dynamometer type wattmeter, Ohm meter, Megger and Induction type Energy meter, their circuit connection and application for measurement of electrical quality.</p>	

9. Electrical Wiring

Types of wiring - Introduction to casing and capping conduit wiring their procedure systems. Factor for selection of a particular wiring system. Importance of switch, fuse; change over switch and earthing of wiring system. Types of faults, their causes and remedies. Methods of finding numbers of circuits and circuit distribution by distribution board system. Indian Electricity Rules (IER) related to wiring. Introduction to submeters and their installation in Inverter wiring.

Types of earthing - Plate Earthing, and pipe Earthing, their procedure and application.

Solar Electricity

Need of Solar Energy, Solar Photovoltaic (SPV) Technology, and advantage of SPV system, Solar Constant, formation of Solar Cells, SPV Module, Array and Applications of Solar Photovoltaic System.

FUNDAMENTALS OF ELECTRICAL ENGINEERING - 2nd year**(Subject Code – 30240002)**

THEORY	PRACTICAL
<p>1. D.C. Machines – General concept of Electrical Machines. Principle of D.C. generator. Use of Armature, Field Coil, Yoke, and Commutator, slip ring Brushes, Laminated core. Explanation of D.C. Generators-types –parts. E.M.F. equation-self excitation and separately excited Generators-Practical uses. Brief description of series, shunt and compound generators.</p>	<p>Identification and study of the parts of a D.C.machine. Practicing dismantling and assembling in D.C. Machine.</p>
<p>2. Expl. Of Armature reaction, interpoles and their uses, connection of interpoles, commutation.</p>	<p>-Connection of shunts Generators, Measurement of voltages-Demonstration on field excitation. - -Connection of compound Generator- Voltage measurement-cumulative and differential – No Load & Load characteristics of Series, Shunt & Compound Generator. Controlling and protecting DC Generator.</p>
<p>3. DC Motors – Terms used in D.C. motor-Torque, speed, Back-e.m.f. etc. their relations practical application. Related problems</p>	<p>Demonstration and practice on identification of parts and terminals. Study of the characteristics of DC motors.</p>
<p>4. Types, characteristics and practical application of D.C. motors. Special precaution to be taken in DC Series motors. Starters used in D.C. motors</p>	<p>-Study of 3 point & 4 point starters. -Connection, starting, running, speed control of motors. Testing of D.C. motors.</p>
<p>5. Types of speed control of DC motors in industry Ward-Leonard control, Thyristor/electronic controls.</p>	<p>Study of Thyristor/electronic control of DC motor. -Routine maintenance.</p>
<p>6. TRANSFORMERS Working principle of Transformer, classification C.T., P.T. Instrument and Auto Transformer/Variac Construction, Single phase and Poly phase. E.M.F. equation, parallel operation of transformer, their connections. Regulation and efficiency, Cooling of transformer, protective devices. Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency. Special transformers. Transformer - construction cores winding shielding, auxiliary parts breather, conservator</p>	<p>Identification of types of transformers. Connection of transformers efficiencies of transformers testing of transformer parallel operation of transformer. Use of C.T. & P.T. use of Instrument transformer. I. Conducting No-load and short circuit tests. Testing of single phase and Three Phase. Transformers - Cleaning and maintenance of Transformers, Changing of oil,</p>

buckholtz relay, other protective devices cooling of transformer Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination.	
7. ALTERNATOR – Explanation of alternator, prime mover, types, regulations, phase sequence, specification of alternators and brushless alternator. Automatic Voltage Regulator.	Demonstration on alternators, voltage Building, load characters & regulation. Practice on installation, running and maintenance of Alternators.
8. Electrical measuring Instruments - -types Deflecting torque, Controlling torque & Damping torque , -Moving coil permanent magnet -Moving iron -Range extension -Multimeter -Wattmeter - P.F. meter -Intergrading type, Digital Energy meter – megger. -Energy meter -Frequency meter - Tri vector meter -Max Demand meter -Phase Sequence indicator -Multimeter –Analog and Digital - C.R.O,	-Study of M.C.P.M. meter -do-Multimeter -do-Wattmeter, P F meter -do- Energy meter -do- Frequency meter -do-Calibration of meter -do-Multimeter -do- C.R.O. -do- Maximum Demand meter -do- Phase sequence indicator -do- Digital Instruments
9. Induction motor – Working principle, Squirrel Cage Induction motor , Slip-ring induction motor- Construction and characteristics, starting and speed control. D.O.L Starter, Star /Delta starter, Autotransformer starter.	Induction Motors - Study of Squirrel cage and Slip ring Induction motor , Measurement of slip, P.F. at various loads. Practice on connection of D.O.L Starter, Star /Delta starter, Autotransformer starter, And starting, running & speed control.
10. Single phase induction motor- Working principle, different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors.	Connection of single phase motor, identification, testing, running, and reversing.
11. Universal motor- advantages Principle, characteristics, applications in domestic appliances and industry, Fault Location and Rectification.	Identification, connection, testing, running and reversing of universal motor. Practice of winding / rewinding.

ELECTRICAL MACHINES - 1st YEAR
(Subject Code – 30240007)

THEORY	PRACTICAL
1. Electromechanical Energy conversion: Basic principles of electro-mechanical energy conversion. Basic aspects and physical phenomena involved in energy conversion. Energy balance. Basic principles of operation of electric generators and motors.	
2. D.C. Machines: Fundamentals of D.C. machine, construction, armature windings : ring and drum windings. Simple lap and wave windings. Chording, Equalizing, connections. Generated voltage.	1. Study of the characteristics of a separately excited D.C generator. 2. Studies of the characteristics of a D.C shunt motor. 3. Speed control of a D.C motor. 4. Study of the characteristics of a compound D.C generator (short shunt) 5. Measurement of the speed of a D.C series motor as a function of load torque.
3. Armature Reaction: Distribution of armature and field mmfs. Cross magnetizing and demagnetizing mmfs and their approximate estimation.	
4. Commutation: Introduction to commutation, reactance voltage, resistance commutation, and interpoles.	
5. DC Generators: Type of D.C. generators. No load and load characteristics of D.C. generators. Parallel operation.	Study of different types dc generators & speed load characteristics
6. DC Motors: Principles of operation, production of torque, back emf, torque-current and torque-speed characteristics of motors, Starting of motors. Speed control by variation of armature voltage, field current and Ward Leonard method. Electrical braking of D.C. motors. Losses and efficiency, direct and indirect tests, Swinburne's test, Hopkinson's test, Field test and retardation test, separation of losses, Rosenberg Generator.	To study torque-current and torque-speed characteristics of motors To study Speed control by variation of armature voltage, field current and Ward Leonard method. Electrical braking of D.C. motors. Losses and efficiency, direct and indirect tests, Swinburne's test, Hopkinson's test, Field test and retardation test, separation of losses, Rosenberg Generator.

1. Control of DC drives: Basic machine equation, operating modes: motoring, and breaking modes. Schemes for dc motor speed control single-phase drive, three phase drive, chopper drive, close loop control, phase-locked-loop control and microcomputer control. Braking operation of rectifier controlled and chopper controlled dc drives.	
7. Transformers: Constructional features, emf equation. No load and load conditions. No load current wave shapes. Ideal transformer. Equivalent circuit. Vector diagrams. O.C. and S.C. tests. Sumpner's back to back test. Efficiency. Voltage regulation. Effect of frequency. Parallel operation, auto-transformers, Switching currents in transformers, Separation of losses.	<ol style="list-style-type: none"> 1. Study of the equivalent circuit of a single-phase transformer. 2. Polarity test on single phase transforms and study of the different connections of three-phase transformer. 3. Load test on single phase transformer. 4. Open circuit and short circuit test on single-phase transformer. 5. Separation of no load losses in a single-phase transformer. 6. Sumpner's test.
ELECTRICAL MACHINES - 2 nd YEAR	
1. Polyphase Transformers: Single unit or bank of single-phase units, polyphase connections. Open delta and V connections. Phase conversion : 3 to 6 phase and 3 to 2 phase conversions. Effect of 3-phase winding connections on harmonics. 3-phase winding transformers, tertiary winding.	<ol style="list-style-type: none"> 2. To perform OC & SC test on a 3-phase transformer & find its efficiency and parameters for its equivalent circuit. 3. To perform parallel operation of two 3-phase transformer and determine their load sharing. 4. To study the performance of 3-phase transformer for its various connections, i.e. star /star star /delta delta /star and delta /delta and find the magnitude of 3rd harmonic current. 5. To make Scott connection & measure the phase difference of secondary voltage by (I) voltmeter method (ii) CRO method. 6. Separation of transformer core losses and to determine the hysteresis and eddy current loss at rated voltage and frequency. 7. To plot the O.C.C. & S.C.C. of an alternator and to determine its regulation by synchronous impedance method.
2. Induction motors: Construction, basic principles, flux and mmf waves, induction motor as a transformer. Equivalent circuits., Circle diagram. Calculation of performance. Torque-slip curves. Effect of rotor resistance. Cogging crawling. Starting, speed control and braking of induction motors. Losses and efficiency. Testing. Induction Generator. Induction regulator. Single – phase induction motor. Revolving field theory. Starting methods.	<ol style="list-style-type: none"> 1) DIFFERENT METHOD OF STARTING OF 3 PHI SQ.CAGE INDUCTION MOTOR & THEIR COMPARISON 2) SPEED CONTROL OF 3 PHI SQUIRREL – CAGE INDUCTION MOTOR BY DIFFERENT METHODS & THEIR COMPARISON[VOLTAGE CONTROL & FREQUENCY CONTROL].

	<ol style="list-style-type: none"> 1. To perform sumpner's back-to-back test on 3 phase transformers, find its efficiency & parameters for its equivalent circuits. 2. To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit. 8) Load test on a wound rotor induction motor & deriving its performance characteristics. 9) Determination of equivalent circuit parameters of a 1 phi induction motor. 10) To make connection diagram of full pitch & fractional slot winding of a 18 slot sq. cage induction motor for 6 pole & 4 poles
3. Control of AC drives: Induction motor drives: Basic principle of operation, stator voltage control, rotor voltage control, frequency control, voltage and frequency control, current control, voltage, current and frequency control, Close-loop control, Synchronous motor drive: Cylindrical rotor, salient pole, reluctance, permanent magnet and switch reluctance motors Close loop control of synchronous motors. Brushless DC and AC drives.	
4. Synchronous machines: Construction, Basic principles, Flux and EMF waves. Theory of cylindrical rotor and salient pole machines. Two reactance theory. O.C. and S.C and Zero power factor characteristics. Potier triangle and ASA method of finding regulation. V-curves, O-curves, and power angle characteristics. Parallel operation. Synchronizing. Hunting and its prevention. Starting of synchronous motors. Single phase synchronous motor. Single phase series and repulsion motor.	<p>3) DETERMINATION OF REGULATION OF AN ALTERNATOR BY SYNCHRONOUS IMPEDENCE METHOD.</p> <p>4) DETERMINATION OF MAGNETISATION CHARACTERISTICS OF AN ALTERNATOR . a) at no – load rated speed b) at no- load half rated speed c) at full load (non inductive load) rated speed.</p>
5. FRACTIONAL HORSEPOWER MOTORS Single phase induction motor – double revolving field theory – equivalent circuit – performance analysis – load characteristics – starting methods – shaded – pole induction motor – variable reluctance motor – stepper motor – hysteresis motor – AC series motor – repulsion motor – linear motor – permanent magnet DC and AC motors.	<p>5) Load test on 1 phi induction motor & deriving its performance characteristics.</p>
