

Maharashtra State Board of Vocational Examination, Mumbai 400 051.

1	Name of Course	Diploma Course In ELECTRICAL ENGINEERING (Revise W.E.F.2017-18)											
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, Lab Sub.– 800 sqft, Lab Elective - 400 sqft Total = 1400 Sq.Ft.											
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 AND ENGG DRAWING	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 AND ENGG DRAWING	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						b) For Elective II – Student can choose any one subject						
		Code	Subject Name			Code	Subject Name						
		90000011	Applied Mathematics			90000021	Applied Sciences (Physics & Chemistry)						
		90000012	Business Economics			90000022	Computer Application						
		90000013	Physical Biology (Botany & Zoology)			90000023	Business Mathematics						
		90000014	Entrepreneurship										
		90000015	Psychology										

THEORY - I**BASIC ELECTRICAL WORKSHOP PRACTICE AND ENGG DRAWING – 1st year
(Subject Code – 30240001)**

Sr.No.	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	Safety Precautions	1 Introduction to shop discipline	Familiarization to shop discipline Safety precautions and practice while working in shop	6	4
		2 Electric shock	Electric shock and causes of electric shock Causes of Electric fire		
		3 First aid	Various safety measures involved in the Industry. Elementary first Aid. Artificial respiration methods Precautions against electric burn Precautions to prevent electric shock and electric fire		
		4 Fire Extinguishers	Introduction to fire extinguishers, types and uses		
2	Hand Tools	1 Introduction	Introduction and identification of hand tools used in electric shop	12	7
		2 Application	Use of Tools. – Pliers, Neon Tester, connector, Screw driver, Knife, S.W.G. Hammers, Hand drill machine, Mallet, Spanners, Bench vice, Test lamp. etc Marking, use of chisels and hacksaw on flats		
		3 Safety precautions and care and maintenance	Safety precautions while using tools care and maintenance of tools		
3	Soldering Materials	1 Introduction	Introduction to soldering and necessity of soldering, Solders, flux, types of flux	6	3
		2 Soldering	Soldering technique, soldering equipment, precautions		
4	Fuse materials	1 Fuse materials	Copper, Lead, Tin, Silver and their alloys as fuse materials, their properties and applications	3	3
5	Electrical Accessories	1 Introduction to common electrical accessories	Introduction Common Electrical Accessories, their specifications,	12	6
		2 Common electrical accessories	Types of switches, lamp holders, plugs and sockets .Developments of domestic circuits, Alarm & switches, lamp, fan with individual switches, two way switches. Required accessories, Ceiling rose, Socket outlet, Plug, connector, Adopter, Terminal block, D. B. and application of Electrical Accessories		

6	Sheet metal	1 Introduction sheet metal	Sheet metal filing practice, filing true to line.	12	3
		2 Sheet metal practice	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.		
7	Sawing and planning	Introduction to sawing and planning	Sawing and planning practice. Practice in using firmer chisel and preparing simple half lap joint.	8	3
8	Drilling	Introduction to drilling	Drilling practice in hand drilling & power drilling machines. Grinding of drill bits.	8	3
9	Tapping and Threading	Introduction to tapping and threading	Practice in using taps & dies, threading hexagonal & square nuts etc. cutting external threads on stud and on pipes, riveting practice.	8	3
10	Engineering Drawing	Introduction to engg drawing	Definition of Engineering Drawing. Uses of Engineering Drawing.	30	15
		2 Geometrical construction	Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, Polygons, etc.		
		3 Lettering	Lettering		
		4 Types of Lines	Different types of line.		
		5 Orthographic Views, Isometric views	1st angle projection, 3rd angle projection. Orthographic views, Isometric views. Drawing of plan, elevation & side views from isometric views		

PRACTICAL - I**BASIC ELECTRICAL WORKSHOP PRACTICE AND ENGG DRAWING – 1st year
(Subject Code – 30240001)**

Sr no	Practical	Skills to be achieved	Time allotted
1	Implementation in the shop floor of the various safety measures.	1 Safety, 2 precautions, 3 identification of switches 4 housekeeping 5 application of firefighting equipment	8
2	Visit to the different sections of the Institute	1 Layout of the institute, 2 introduction to other sections	4
3	Demonstration on elementary first aid.	1 application of first aid	4
4	Artificial Respiration	1 Rescue a person from live wire 2 apply respiratory resuscitation	8
5	Demonstration of Trade hand tools.. Use, care & maintenance of various hand tools.	1 identification of the tools 2 use different hand tools 3 care and maintenance	8
6	Identification of simple types- screws, nuts & bolts, chassis, clamps, rivets etc	1 identify screws nut, bolts, clamps, rivets	8
7	Practice in using cutting pliers, screw drivers etc. skinning the cables, and joint practice on single strand.	1 Use of cutting pliers & screw driver 2 Skinning of cable	12
8	Demonstration & Practice on bare conductors joints--such as Britannia, straight	1 Mark the length of insulation to be removed 2 To join single strand conductor 3 To join bare conductor 4 prepare Britannia joint 5 prepare straight joint	12
9	Demonstration & Practice on bare conductors joints--such as, Tee, Western union joints	1 Mark the length of insulation to be removed 2 To join single strand conductor 3 To join bare conductor 4 prepare tee joint 5 prepare western joint	8
10	Types of soldering irons-their proper uses. . Soldering materials, fluxes and process.	1 solder the joints 2 use of flux	12

11	Practice in soldering	1 soldering practice	8
12	Measurement of Resistant and Measurement of specific Resistant.	1 connection of voltmeter 2 connection of ammeter 3 measure the resistance 4 measurement of specific resistance	12
13	Application of Wheatstone bridge in measurement of Resistance	1 Connection Wheatstone bridge 2 measure the resistance by Wheatstone bridge	8
14	Practice on installation and overhauling common electrical accessories. - Identification and use of wiring accessories	1 identification of specified electrical accessories 2 use of electrical accessories	16
15	Fixing of switches, holder plugs etc. in T.W. boards.	1 select the correct size of boards 2 position the accessories 3 wire up and test the board	16
16	Introduction of fitting trade. Safety precautions to be observed use of files, hammers, chisels steel rule try square - their specification Care & maintenance of tools	1 safety in fitting shop 2 use of hand tools as files, hammers, chisels etc 3 care and maintenance	16
17	Safety precautions to be observed use hacksaw frames & blades-their specification & grades. Care & maintenance of tools.	1 use of hacksaw 2 specification and grades hacksaw blades 3 care and maintenance	12
18	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.	1 identification of marking tools 2 use of marking tools 3 care and maintenance	12
19	Holding tools-their care and maintenance.	1 identification of holding tools 2 use of holding tools 3 care and maintenance	8
20	Types of drills description & drilling machines, proper use, care and maintenance.	1 use of drill machines 2 care and maintenance of drill machine	16
21	Description of taps & dies, types in rivets & riveted joints. Use of thread gauge.	1 use of tap & dies 2 types of rivets & riveted joints 3 use of thread gauge	8
22	Description of marking tools such as snubs shears punches & other tools like hammers mallets etc. used by sheet metal workers. Use of different bench	1 identification of marking tools 2 use of marking tools 3 care and maintenance 1 identification of cutting tools	16

	tools used by sheet metal worker	2 use of cutting tools 3 care and maintenance of cutting tools 4 use different bench tools	
23	Freehand sketching of straight lines, rectangles, squares, circle polygons etc.	1 Freehand sketching of straight lines , 2 Freehand sketching of rectangles 3 Freehand sketching of squares 4 Freehand sketching of circle 5 Freehand sketching of polygons	12
24	Lettering practice	1 use of drawing instruments 2 lettering	12
25	Drawing of different types of line	1 drawing of lines, 2 use of sets square	8
26	Drawing of different blocks	1 drawing of blocks 2 use of sets square	8
27	Practice on Geometrical construction of Square, Rectangle, Triangle, Circle, Ellipse, , etc	1 construct Square, Rectangle, Triangle, Circle, Ellipse, , etc	16

Theory - I

BASIC ELECTRICAL WORKSHOP PRACTICE AND ENGG DRAWING - 2nd Year (Subject Code – 30240001)

Sr no	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	Conducting Materials	1 Introduction	Introduction to conducting materials	6	3
		2 Classification	Copper and aluminum as low resistively materials their electrical characteristics and application		
		3 Application	Electric resistance materials. Materials for lamp filaments and Brushes. Tungsten, Nichrome, Eureka, Selenium and Carbon as high resistively materials, their electrical characteristics and application.		
2	Insulating materials	1 Introduction	Introduction to insulating materials, Distinction between conductor, insulator and semi conductor, definitions of insulation resistance, dielectric strength breakdown voltage	6	3
		2 Classification	Classification of insulating materials according their insulating resistance, temperature withstanding capacity		
		3 Application	Various insulating Materials : Paper, plastic coated Paper. Empire cloth Leatherwood Cotton and silk, Rubber, PVC Porcelain, Bitumen, Micro, Bakelite, Ebonite, Marble, Glass Asbestos, Fiber glass-their uses		

			and applications insulating tapes, Sleeves, insulating and impregnating Varnishes and paints- Their uses and application.		
3	Magnetic Materials	1 Introduction	Introduction of Magnetic Materials	6	4
		2 Classification	Classification of materials as Ferromagnetic materials, soft and hard magnetic material		
		3 Application	Various magnetic materials- Mild steel, silicon steel, Mu-metal, Permalloy, Alnico as magnetic materials their properties and uses.		
4	Structure Materials	1 Introduction	Introduction of structure materials	3	4
		2 Application	Various structural materials- Iron Steel, Brass, Gun Metal and Aluminum as structural materials, their properties and applications.		
5	Semiconductor materials	1 Introduction	Introduction of semiconductor materials	9	4
		2 Application	Electric properties of semi-conducting elements and compounds and their application. Zone refining and crystal growth.		
6	Lubricants	1 Introduction	Introduction to lubricants	6	4
		2 Application	Lubricants : Solid, semi-solid and liquid lubricants- uses and applications.		
7	Wire joints and their importance	1 Importance of wire joints,	Importance of wire joints, reasons for failure of joint, methods of minimizing joint failures.	12	4
		2 Importance of lugs	Importance of lugs in joints, bus bars, methods of reducing the contact/joint resistance,		
		3 Types of wires	Size of wires, different Types of wires, Single & multi conductor cables.		
		4 wire joints	Wires & wire splicing & termination - Wire splicing & termination , Twist splice four steps Married joint , Tap joint , Double Branch splice , Tap joint , Flexible cord Splicing , Pigtail , Termination of wires at terminal screws.		
8	Engg Drawing	1 Two-dimensional geometrical construction	Two-dimensional geometrical construction – conic sections, involutes and cycloids	18	8
		2 Representation of three-dimensional objects	Representation of three-dimensional objects – principles of projections – standard codes of principles.		

		3 Orthographic Views, Isometric views	Practice of drawing Orthographic Views, Isometric views		
9	Hardware	1 Introduction to hardware	Introduction to Hardware – display technology	15	6
		2 Introduction to software	Software – introduction to drafting software.		
10	Shop Problems	1 Basic workshop based problems	1 units and conversions 2 ratios and proportion, percentage, 3 Algebra-simultaneous, quadratic equations 4 Mensuration-Area of plane figures, volume of solid figures 5 Trigonometry	24	10
		2 Work, Power and Energy and workshop science	1 Work, Power & Energy – Their units and related problems 2 Dynamics-speed, velocity, angular velocity, laws of motions, laws of forces, graph etc 3 simple machines- lever, pulley, screw jack, etc 4 friction- types, laws of friction 5 density and sp gravity etc		

Practical - I

BASIC ELECTRICAL WORKSHOP PRACTICE AND ENGG DRAWING - 2nd Year (Subject Code – 30240001)

Sr no	Practical	Skills to be achieved	Time allotted
1	Study of conducting materials	1 identification of the conducting material . 2 use different conducting	12
2	To make coil of nichrome and ureka wire of equal resistance	1 making coil of nichrome and ureka wire 2 measure resistance of both wire of equal length	24
3	measurement of current and power at given voltage	1 connection of wattmeter 2 connection of ammeter 3 measure the current 4 measure the power	20
4	Identification of insulating materials	1 study of insulating of material 2 properties of insulating material	12
5	Use of insulating materials in electric field	1application of insulating materials	12
6	Study of magnetic materials	1 study of magnetic of material 2 properties of magnetic material	12
7	Identification of magnetic and non magnetic materials	1identification of magnetic materials 2identification of non-magnetic materials	8
8	Study of structural materials	1 study of structural of material 2 properties of structural material 3 use of structural material	12
9	Study of semi-conducting materials	1 study of semi-conducting of material 2 properties of semi-conducting material	16
10	Application of semiconducting materials	1 use of semi-conducting material. 2 properties of semi-conducting material	8

11	Study of lubricating materials	1 study of lubricating material 2 properties of lubricating material 3 use of lubricating material	8
12	Application of lubricants	1 use of lubricating material	8
13	Making of different types of wire joints, fixing of lugs.	1 Mark the length of insulation to be removed 2 To join single strand conductor 3 To join bare conductor 4 prepare joints 5 crimping the lugs	28
14	Practice on Geometrical construction of involutes	1 construction of involutes	20
15	Practice on Geometrical construction of cycloids	1 construction of cycloids	20
16	To study of hardware display	1 introduction of hardware 2 application	20
17	To study of drafting software	1 introduction of drafting software 2 use of drafting software	40

THEORY - II**FUNDAMENTALS OF ELECTRICAL ENGINEERING – 1st year
(Subject Code – 30240002)**

SR NO	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	Current Electricity	1 Introduction to electricity	Introduction to electricity, electricity and its sources Nature of electricity types, Generation of electricity	12	6
		2 Electron Theory	Electron theory- free electron. Structure of an atom		
		3 Effects of electric current	Effects of electric current		
		4 Laws of Resistance	Factors affecting resistance of a conductor. Temperature coefficient of resistance, sp resistance		
		5 Definitions	Definition of Resistance, Voltage, Current, Power, Energy and their units, . Difference between ac and dc voltage Electric circuit, types of electric circuit		
2	D.C. Circuits	1 Ohms law	Ohm's Law Relation between voltage and current in a dc circuit.	12	6
		2 Series and parallel circuits	Series and Parallel resistance circuits and their equivalent resistance. Series-Parallel Resistance circuits, calculation of equivalent resistance		
		3 Kirchhoff's laws	Kirchhoff's laws and Their applications.		
3	Batteries	1 Introduction	Introduction of cells and batteries, production of emf by chemical action primary and secondary cells	12	4
		2 Grouping of cells	series and parallel, series- parallel connection of cells.		
		3 Secondary cells	Lead acid cell- construction, discharging and recharging of battery, efficiency, charging methods, precautions, application, alkaline cells- construction application		
		4 Care and maintenance	Testing, care and maintenance of battery,		
4	Heating and Lighting Effects of Current	1 Heating effect	Heating effect of electric current: Joule's Laws of electric heating and its applications, heating efficiency	9	6
		2 Lighting effect	Lighting effect of electric current, Filaments used in lamps, lamps and gas Discharge lamps, their specifications, working and applications.		

5	Capacitors	1 Introduction of capacitors	Introduction to Capacitors, capacitance, energy stored in capacitor, application. Charging and discharging of capacitors.	6	4
		2 Combination of capacitors	Types of capacitors and their use in circuits. Series and parallel connection of capacitors		
6	Electromagnetism	1 Introduction	Introduction, definitions of magnet and properties of magnet, types of magnet, fundamental magnetic terms	12	6
		2 Electromagnetism	Permanent magnets and electromagnets their construction and application. Electromagnetism, magnetic rules electromagnetic induction, Faraday's Laws of electromagnetic induction, dynamically induced emf, and statically induced emf, direction. Self induction, mutual induction, Flemings left hand rule, Lenz's law		
7	A.C. Circuits	1 Introduction	Introduction to generation of A.C .Definitions, Principles of Generation of A.C. voltage and wave shape Cycle, frequency, peak Value (maximum value) average value, instantaneous value, R.M.S.value, phase, phase difference	12	6
		2 Different types of ac circuits	Introduction to resistance, capacitance and inductance, inductive reactance and capacitive reactance, impedance power factor (Leading and lagging). A.C Circuits with R, L and C ,A.C Circuits with (i) resistance and inductance, (ii) resistance and capacitance (iii) resistance, inductance and capacitance in series. Introduction of ac parallel circuit of R L C		
		3 polyphase system	Three phase system, phase sequence, definitions, star and delta connections of windings		
8	Measuring instruments	1 Introduction	Introduction of Measuring instruments, types of measuring instruments, deflecting torque, controlling torque & damping torque	12	5
		2 Working, construction of various instruments	Working principles of moving iron and moving coil voltmeters and ammeters, extension of instrument range, dynamometer type wattmeter, Ohm meter,		
		3 Types of Measuring Instruments	Working and application of P.F. meter - Energy meter --Energy meter digital -Frequency meter -Phase Sequence indicator -Multimeter –Analog and Digital - C.R.O, megger.		

9	Electrical Wiring	1 Introduction of electrical wiring	Introduction to electrical wiring, wiring systems, selection of wiring	18	7
		2 Types of wiring	Types of wiring - Introduction to casing and capping conduit wiring, raw material required for all types of wiring, procedure. Method of Installing wiring for domestic installations - Cleat, T .R .S Metal Sheathe conduit . All system comparison Testing of wiring, 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 of inverter wiring.		
		3 Earthing	Earthing purpose, General Specifications of as per I .S .I .		
		4 methods	Methods – Pipe earthing, Plate earthing ,		
		5measuring earth resistance	Methods of Measuring Earth Resistance. – Potential drop & Earth tester .		
		6 factors affecting earth resistance	Factor affecting Earth Resistance .Points considered as per I.E.E. Testing by megger.		
		7 ELCB	Introduction of ELCB, working, application		
		8 Solar electricity	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.		

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

Sr no	Practical	SKILLS TO BE ACHIEVED	Time allotted
1	Measurement of current, voltage and resistance of the help of millimeter	1. Measurement of current with millimeter 2. Measurement of voltage with millimeter 3. Measurement of resistance with multimeter	8
2	Verification of Ohm's Law.	1.Connect meters in proper sequence 2.reading the meter 3.Verify ohm's law experimentally	8
3	Measurement of equivalent resistance of series combination of resistors.	1. Connect resistances in series 2.Calculate equivalent resistance of series combination of resistors.	8
4	Measurement of equivalent resistance of parallel combination of resistors	1. Connect resistances in parallel 2.Calculate equivalent resistance of parallel combination of resistors.	8
5	Measurement of equivalent resistance of series-parallel components of resistors.	1. Connect resistances in series parallel 2.Calculate equivalent resistance of series parallel combination of resistors.	8
6	To verify Kirchhoff's current laws.	1.Connect meters in proper sequence 2.reading the meter 3.Verify Kirchhoff's law experimentally	8
7	Charging a lead acid battery and to test its state of charge.	1. Connect battery for charging 2.Test the charging with hydrometer 3. Use of hydrometer	8
8	Study of series and parallel capacitor circuits.	1.Connection of capacitor in series & parallel 2.calculation of capacitive reactance with formulae	8
9	Study of series and parallel resistor circuits/lamps.	1.Connection of resistor/lamp in series & parallel 2.calculation of equivalent resistance with formulae	8
10	Study of R.L. series circuit and measurement of impedance, power and power factor.	1. Connection of R-L in series 2. Calculate impedance 3.calculate power 4. Calculate power factor	8
11	Study of R.C. series circuit and measurement of impedance, power and power factor.	1. Connect R-C in series 2. Calculate impedance 3.calculate power 4. Calculate power factor	8
12	Study of R.L.C. series circuit and measurement of impedance, power and power factor.	1. Connect R-L-C in series 2. Calculate impedance 3.calculate power 4. Calculate power factor	12

13	To test a single phase energy meter with the help of standard wattmeter and stop watch with resistive load.	1. Connect single phase energy meter 2. Connect standard wattmeter 3. Use of stop watch 4. Find out the error	8
14	Controlling low voltage lamps in series	1. Connect low voltage lamps in series 2. Calculate no. of lamps	8
15	Controlling lamps from two or three places	1. Choose proper switches 2. Selection of proper wiring system	12
16	Drawing schematic diagram of single phase supply to consumers.	1. Identify single phase supply. 2. Draw schematic diagram 3. Connection of single phase supply to consumer	8
17	Drawing schematic diagram of three phase supply to consumers.	1. Identify three phase supply. 2. Draw schematic diagram 3. Connection of three phase supply to consumer	8
18	Practice on CTS/TRS (Batten) wiring with 2 fans, 4 lamps, 2 tubes and 4 plug points.	1. Marking the wiring diagram 2. Mark the position of fans 3. Mark the position of lamps 4. Mark the position of tubes 5. Select the proper size of link clips	16
19	Practice on conduit wiring	1. Marking the wiring diagram 2. Mark the position of accessory 3. Cutting of Conduit 4. Selection of conduit size	16
20	Polarity test of wiring installation (means phase and neutral testing).	1. Use of neon tester 2. Check polarity of wiring installation	8
21	Measurement of insulation resistance of wiring installation by megger.	1. Use of megger 2. Measure insulation resistance with megger	8
22	Testing of wiring installations with the help of megger.	1. Use of megger 2. Test the wiring installation for continuity or open ckt 3. Test wiring	12
23	Installation of pipe earthing for wiring installation.	1. Prepare pipe earthing 2. Install pipe earthing	16
24	Study of plate earthing for wiring installation.	1. Prepare plate earthing 2. Install plate earthing	12
25	Testing faults of wiring installation and rectification.	1. Test wiring installation 2. Rectify the faults 3. Repair the faults	12

26	Installation of a sub-meter between a given electrical wiring.	1.Use of sub meter 2.install sub meter in wiring system	12
27	Measurement of open Circuit Voltage and short circuit current of a PV Module	1.measuring open ckt voltage 2 measuring of short ckt voltage	8
28	To study/Install a Solar Street light System.	1 solar system awareness 2 installation of solar system 3 commissioning of solar system	16

THEORY - II

FUNDAMENTALS OF ELECTRICAL ENGINEERING - 2nd year

(Subject Code – 30240002)

SR NO	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	1. D.C. Machines	1 Introduction	D.C. Machines – General concept of Electrical machines. Principle of D.C. generator. Construction of generator parts of generator, armature, Field coil, Yoke, and commutator, slip ring brushes, core.	15	6
		2 Types of generators	D.C. Generators-. E.M.F. equation- types -self excited and separately excited Generators-application. Brief description of series, shunt and compound generators		
		3 Armature reaction	Armature reaction, interpoles and their uses, connection of interpoles, commutation.		
2	DC Motors	1 Introduction	Introduction to DC Motors – Terms used in D.C. motor-Torque, speed, Back-e.m.f. etc. their relations practical application. Related problems, change of DOR	15	6
		2 Types of dc motors	Types, characteristics and application of dc. motors. Special precaution to be taken in dc Series motors. Testing fault finding of dc motor		
		3 DC motor starters	Starters used in D.C. motors, necessity, types, working		
		4Speed control methods	Methods of speed control of DC motors Word-Leonard control, Thyristor/electronic controls.		
3	Transformer	1 Introduction	Introduction to Transformer construction, classification	15	10
		2Working principle, construction	Working principle of Transformer, E.M.F. equation, Regulation and efficiency, Cooling of transformer, protective devices. Specifications, simple problems on e.m.f. Equation, turn ratio, regulations and efficiency.		

			Oil field Transformer - construction cores winding shielding, auxiliary parts breather, conservator buckholtz relay, other protective devices cooling of transformer Transformer oil testing and Tap changing off load and on load. Transformer bushings and termination		
		3Types of transformer	C.T., P.T. Instrument and Auto Transformer/Variac Construction, Single phase and Poly phase.		
		4Parallel operation	Parallel operation of transformer, their connections.		
4	Alternator	1 Introduction	Introduction of Alternator –, working principle, parts of alternator, rating of alternator, prime mover, losses in alternator,	18	6
		2 Types	Types, regulations, phase sequence, specification of alternators and brushless alternator, synchronizing of alternators		
6	Induction motor	1 Introduction	Introduction of Induction motor – Working principle	15	8
		2 Types of motors, construction	Squirrel Cage Induction motor , Slip-ring induction motor- Construction and characteristics, starting and speed control. Speed regulation of A .C . 3 phase I .Motor change of DOR		
		3 Starters	D.O.L Starter, Star /Delta starter, Autotransformer starter. Working, construction Installation of A .C . I .Motor		
7	Single phase induction motor-	1 Introduction	Introduction of Single phase induction motor- Working principle,	9	5
		1 Types	Different method of starting and running (capacitor start/capacitor run, shaded pole technique). FHP motors. Application change of DOR		
8	Universal motor	1Introduction	Universal motor-advantages working Principle, characteristics change of DOR	9	5
		2 Application	Universal motor- applications in domestic appliances and industry, Fault Location and Rectification.		
9	Basic electronic Components and Devices	1Introduction	Introduction Basic electronic Components and Devices	9	4
		2Basic electronic Components	Diodes and Types of Diodes Introduction of electronic devices. Silicon diode, Zener diode Light emitting diode Rectifier (Half wave, full wave, bridge rectifier)Introduction of Transistor Construction and working of Transistor Testing and terminal identification of diode, transistor, SCR, Diac, Triac		

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

Sr no	Practical	SKILLS TO BE ACHIEVED	Time allotted
1	Identification and study of the parts of a D.C.machine.	1. Identify parts of d.c. machine 2.function of parts of d.c. machine	4
2	Practicing dismantling and assembling in D.C. Machine.	1. Dismantle d.c. machine 2.Assemble d.c. machine	4
3	Connection of shunts Generators, Measurement of voltages-Demonstration on field excitation.	1. Connect shunt generator 2.identify field winding 3. Identify terminals of shunt generator 4.measure voltages	4
4	Connection of compound Generator-Voltage measurement-cumulative and differential	1. Connect compound generator 2.identify field winding 3.Identify terminals of compound generator 4.measure voltages	4
5	No Load & Load characteristics of Series, Shunt & Compound Generator.	1. Connect the generator 2.verification of no load & load characteristics of generator	4
6	Controlling and protecting DC Generator	1.To control D.C. generator 2.To protect D.C. generator	4
7	Demonstration and practice on identification of parts and terminals.	1. identify terminals of d.c. motor 2.To identify parts of d.c. motor	4
8	Study of the characteristics of DC motors.	1.connection of dc motors 2 verify the characteristics of d.c. motor	8
9	Study of 3 point starters.	1. Connections of starter 2 identification of parts of starter 3function of parts of starter 4. connect three point starter to motor	4
10	Study of 4 point starters.	1. Connections of starter 2 identification of parts of starter 3function of parts of starter 4. connect three point starter to motor	8
11	-Connection, starting, running, speed control of motors. Testing of D.C. motors	1. Connection of dc motors 2 to run dc motors 3 Control speed of d.c. motor 2. test d.c. motors	8
12	Testing of D.C. motors	1 testing of dc motors 2.trace the armature & field terminals.	8
13	Study of Thyristor/electronic control of DC motor.	1 study of thyristor 2 electronic control of dc motors	8

14	Routine maintenance of dc motor.	1. testing of dc motor 2 maintenance d.c. motor	12
15	Identification of types of transformers. Connection of transformers	1. Identify types of transformers 2. connect transformer	12
16	Efficiency of transformers	1. Calculate losses in transformer 2. calculate efficiency of transformer	8
17	Use of C.T. & P.T. use of Instrument transformer.	1.Use of C.T. 2.Use of P.T.3 connection of CT/PT in the ckt	8
18	Parallel operation of transformer.	1. Connections for parallel operation 2 perform parallel operation of transformer 2. Need of parallel operation 3.Condition for parallel operation	12
19	Conducting No-load and short circuit tests.	1. Conduct no load test 2. Conduct short circuit test 3. calculate losses in transformer	8
20	Testing of transformer. Testing of single phase and Three Phase. Transformers -	1. identify single phase & three phase transformer	12
21	Cleaning and maintenance of Transformers, Changing of oil	1.Clean the transformer 2.maintain the transformer 3.change the oil of transformer	8
22	Demonstration on alternators, voltage Building, load characters & regulation	1. identify the terminals of alternator 2.study the load characteristics & regulation	16
23	. Practice on installation, running and maintenance of Alternators.	1. install & connect the alternator 2.run the alternator 3. Maintain the alternator	12
24	-Study of M.C.P.M. meter Study of Multimeter	1. identify & connect the terminals of different meters 2.To connect different types of meters	8
25	Study of Wattmeter, P F meter	1. identify & connect the terminals of different meters 2.To connect different types of meters	8
26	Study of Energy meter Study of Frequency meter Study of Maximum Demand meter	1. identify & connect the terminals of different meters 2.To connect different types of meters	8

27	Study of Calibration of meter	1. identify & connect the terminals of different meters 2.To connect different types of meters 3.Calibrate the meter	8
28	Study of C.R.O.	1. Study C.R.O.	8
29	- Study Phase sequence indicator -Study Digital Instruments	1. Study phase sequence indicator 2.Study digital instruments	8
30	Induction Motors - Study of Squirrel cage.	1. identify types of induction motor 2.Study the different parts of motor	8
31	Induction Motors - Study of Slip ring Induction motor ,	1. Identify parts of Slip ring Induction motor 2.function of parts of Slip ring Induction motor	8
32	Induction Motors Measurement of slip, P.F. at various loads.	1. measurement of slip 2 measurement of p.f. at various loads	8
33	Induction Motors - Study of and Practice on connection of D.O.L Starter	1. Connections of starter 2 identification of parts of starter 3function of parts of starter 4. connect D.O.L starter to motor	4
34	Induction Motors study of Star /Delta starter	1. Connections of starter 2 identification of parts of starter 3function of parts of starter 4. connect D.O.L starter to motor	4
35	Induction Motors - Study of Autotransformer starter starting, running & speed control.	1. Connections of starter 2 identification of parts of starter 3function of parts of starter 4. connect D.O.L starter to motor	4
36	Induction Motors - starting, running & speed control.	1 connections of induction motor 2 to run the motor 3 measurement of speed of IM	4
37	Connection of single phase motor, identification, testing, running, and reversing.	1. Connections of single phase motor 2 identification of parts of single phase motor 3function of parts of single phase motor 4. connect single phase motor 5 reversing of single phase motor	4
38	Identification, connection, testing, running and reversing of universal motor.	1. Connections of universal motor 2 identification of parts of universal motor 3function of parts of universal motor 4. connect universal 5 reversing of universal	8

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

SR NO	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	Electrical symbols	1 Symbols	Electrical symbols Electrical drafting and abbreviations, Graphical symbols- supply , conductor , switches , lamps , fitting , electrical appliances , parameters , instruments, machines, transformer , electrical panel , star / delta	9	4
2	Fuse	1 Introduction	Introduction of Fuses. Importance Definitions working	12	5
		2 Types of fuses	Main types of Fuses Fuse fitting arrangement		
3	Electromechanical Energy conversion	1 Energy conversion	Introduction of 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	21	9
4	D.C. Machines	1 Armature winding	armature windings : ring and drum windings. Simple lap and wave windings. Chording, Equalizing, connections. Generated voltage.	21	12
		2 Armature Reaction	Armature reaction Terms used in armature reaction, effects of armature reaction, remedies for armature reaction		
		3 Commutation	Introduction to commutation, , methods of removing commutation resistance commutation, and interpoles		
		4 DC Generators	Type of D.C. generators. No load and load characteristics of D.C. generators. Parallel operation		
		5 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.		
		6 losses and efficiency	Losses and efficiency, direct and indirect tests, Swinburne's test, Hopkinson's test, Field test and retardation test, separation of losses, Rosenberg Generator.		
5	Control of DC drives	1 introduction	Introduction, Basic machine equation, operating modes: motoring, and braking modes.	21	10
		2 types	Schemes for dc motor speed control, chopper drive, close loop control, phase-locked-loop control and microcomputer control. Braking operation of rectifier controlled and chopper controlled dc drives		

6	Transformers	1 Ideal transformer	Constructional features, Ideal transformer. Equivalent circuit. Vector diagrams, emf equation	21	10
		2 tests, efficiency	. No load and load conditions. No load current wave shapes.. O.C. and S.C. tests. Sumpner's back to back test. Effect of frequency. Parallel operation,		
		3 auto transformer	auto-transformers, types, adv, application		

PRACTICAL - III - ELECTRICAL MACHINES – 1st year
(Subject Code – 30240007)

Sr no	Practical	SKILLS TO BE ACHIEVED	Time allotted
1	Study & identify the parts of D.C. Machine.	1. Identify the parts of D.C.Machine.2.study the function of each part.	12
2	To identify the terminals of D.C. Generator.	1. Identify the terminals of D.C.Generator.2.study the function of each part.	8
3	To identify the types of D.C. Generator.	1. Trace the connection of field wdg.2.identify the types of generator.	12
4	Study the characteristics of a separately excited D.C generator.	1.Connection of generator as per ckt. Dia.2.study the characteristics of generator.	12
5	Study the Characteristics of a D.C shunt motor.	1.Connection of generator as per ckt. Dia.2.study the characteristics of generator.	12
6	Speed control of a D.C motor.	1. Connection of d.c.motor.2.study the types of speed control.	8
7	Study of the characteristics of a compound D.C generator (short shunt)	1. Connection of generator as per ckt. Dia.2.study the characteristics of generator.	12
8	Measurement of the speed of a D.C series motor as a function of load torque.	1. Connection of series motor.2.study load torque characteristics.	8
9	Study of different types dc generators.	1. Connection of field winding.2.identify the type of generator according to field connection.	12
10	Study of speed load characteristics of D.C. Generator.	1. Connection of generator as per ckt. Dia.2.study the characteristics of generator.	8
11	To study torque-current and torque-speed characteristics of motors	1. Connection of motor as per ckt. Dia.2.study the characteristics of motor.	12

12	To study Speed control by variation of armature voltage .	1. Study the principle of speed control.2.control armature voltage.3study the speed variation.	12
13	To study Speed control by variation of field current.	1. Study the principle of speed control.2.control field current.3study the speed variation.	12
14	To study Speed control by Ward Leonard method.	1. Study the principle of speed control.2.study the speed variation.	8
15	Electrical braking of D.C. motors.	1. Study the starting torque of D.C. Motor.2.Brake test of motor.	12
16	To calculate Losses and efficiency, direct and indirect tests on D.C. motor.	1. Test the D.C. Motor.2. Calculate the losses .3.Calculate the efficiency of D.C.Motor.	12
17	To perform Swinburne's test	1.	8
18	To perform Hopkinson's test		16
19	To perform Field test and retardation test		16
20	Study of the equivalent circuit of a single-phase transformer.	1. Connection of transformer.2.study the equivalent circuit of transformer.	8
21	Polarity test on single phase transformer.	1. Use of test lamp & neon tester.2.test the polarity of transformer.	8
22	Study of the different connections of three-phase transformer.	1. Connection of three phase transformer.2.study the different types of connection.	12
23	Load test on single phase transformer.	1. Connection of transformer.2.caloculation of iron & copper losses.	16
24	Open circuit and short circuit test on single-phase transformer.	1. Connection of transformer.2.caloculation of iron & copper losses.	12
25	Separation of no load losses in a single-phase transformer.	1. Connection of transformer. .2.calculation of iron & copper losses.	12

THEORY - III - ELECTRICAL MACHINES - 2 nd YEAR

(Subject Code – 30240007)

SR NO	UNIT	SUB UNIT	SCOPE & LIMITATION	Hours	Marks
1	Polyphase Transformers	1 polyphase transformer	Single unit or bank of single-phase units, Polyphase connections.. Star/delta connections, open – delta 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 cooling,	21	10
		2 instrument transformer	C T / P T Application		
		3 Trouble shooting of transformer	Defects, causes and remedies		
2	Induction motors	1 induction motor as transformer	Construction, basic principles, Revolving field theory flux and mmf waves, induction motor as a transformer. Equivalent circuits.. Starting methods	24	12
		2 Circle diagram	Circle diagram. Calculation of performance. Torque-slip curves. Effect of rotor resistance. Cogging crawling..		
		3 speed control	Starting, speed control and braking of induction motors		
		4 Testing	Testing Losses and efficiency.. Induction Generator. Induction regulator. Single – phase induction motors..		
3	Control of AC drives:	1 Induction motor 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,	18	8
		2 Synchronous motor drive	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	1 principle of operation	Synchronous motor, principle of operation, Basic principles, Construction 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..	21	10
		2 Starting of synchronous motors.	Starting of synchronous motors. Single phase synchronous motor. Single phase series and repulsion motor.		
		3 Parallel operation	Parallel operation. Synchronizing. Hunting and its prevention		
		4 Trouble shooting	Testing, Defects, causes and remedies		

5	Fractional Horsepower Motors	1 principle of operation	Single phase induction motor – double revolving field theory – equivalent circuit – performance analysis – load characteristics –	21	10
		2 starting methods and types	starting methods used– shaded – pole induction motor – variable reluctance motor – hysteresis motor – AC series motor –repulsion motor – linear motor – permanent magnet stepper motor DC and AC motors.		
		3Trouble shooting	Testing, Defects, causes and remedies		

PRACTICAL - III - ELECTRICAL MACHINES – 2nd year
(Subject Code – 30240007)

Sr no	Practical	SKILLS TO BE ACHIEVED	Time allotted
1	To perform OC & SC test on a 3-phase transformer & find its efficiency and parameters for its equivalent circuit.	1. Connection of transformer.2.caloculation of iron & copper losses.	16
2	To perform parallel operation of two 3-phase transformer and determine their load sharing.	1. Identify phase sequence Of both transformer.2.connect them in parallel.3.find out their load sharing.	16
3	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 3 rd harmonic current.	1. Various types of connections of transformers.2.purpose of such connection.3.difference between phase & line voltage.	16
4	To make Scott connection & measure the phase difference of secondary voltage by voltmeter method.	1. Connection of transformer.2.measure the secondary voltage.	12
5	To make Scott connection & measure the phase difference of secondary voltage by CRO method.	1. Connection of transformer.2.measure the secondary voltage.	12
6	Separation of transformer core losses and to determine the hysteresis and eddy current losses at rated voltage and frequency.	1. Connection of transformer.2.measure the losses.	12
7	To plot the O.C.C. & S.C.C. of an alternator and to determine its regulation by synchronous impedance method.	1. Connection of transformer.2.measure the losses.	12
8	Different methods of starting of 3 phase squirrel cage induction motor.	1. Study starting properties of motor.2.connection of motor.3.start & run the motor.	12
9	Speed control of 3 phase squirrel cage induction motor by voltage control method.	1. Connection of motor.2.to control the voltage.3.study the speed variation.	16
10	Speed control of 3 phase squirrel cage	1. Connection of motor.2.to control the	16

	induction motor by frequency control method.	frequency.3.study the speed variation.	
11	To perform sumpner's back-to-back test on 3 phase transformers, find its efficiency & parameters for its equivalent circuits.	1. Connection of transformer.2.measure the losses.3.find the equivalent circuit.	12
12	To perform the heat run test on a delta/delta connected 3-phase transformer and determine the parameters for its equivalent circuit.	1. Connection of transformer.2.measure the losses. 3. Find the equivalent circuit.	12
13	Load test on a wound rotor induction motor & deriving its performance characteristics.	1. Connection of motor.2.to derive the characteristics.	16
14	Determination of equivalent circuit parameters of a 1 phase induction motor.	1. Connection of motor.2.to derive the characteristics.3.find the parameters of motor for equivalent circuit.	12
15	To make connection diagram of full pitch & fractional slot winding of 18 slot sq. cage induction motor for 6 pole & 4 poles.	1. Study the pole pitch & no. of poles.2.draw the diagram of winding.	16
16	To determine regulation of Alternator by synchronous impedance method.	1. Connection of alternator.2.determine the regulation.	12
17	To determine magnetization characteristics of Alternator at no load rated speed.	1. Connection of alternator.2.determine the characteristics.	16
18	To determine magnetization characteristics of Alternator at no load half rated speed.	1. Connection of alternator.2.determine the characteristics.	16
19	To determine magnetization characteristics of Alternator at full load rated speed.	1. Connection of alternator.2.determine the characteristics.	16
20	Load test on 1 phase induction motor & deriving its performance characteristics.	1. Connection of motor.2.determine the characteristics.	12

LIST OF MATERIALS FOR 25 STUDENTS.**BASIC ELECTRICAL WORKSHOP PRACTICE AND ENGG DRAWING**

Sr. No	Details of Materials	Quantity
1	Voltmeter a.c. 0—250v	4 no
2	Ammeter A.C. 0—5 Amp.	4 no
3	Wattmeter 0—250W	1 no
4	Energy meter 5-15Amp.	1 no
5	Three phase main switch 16 amp.	2 no
6	Three phase main switch 32 amp.	2 no
7	Rain coats	10 no
8	Multi meter	4 no
9	Hacksaw with blade	6 no
10	Hand Drill machine	2 no
11	Screw Driver	20 no
12	Hammer	10 no
13	Pocker	8 no
14	Files	10 no
15	Wire stripper	10 no
16	Tester	10 no
17	Pliers	10 no
18	Electrician knife	10 no
19	Mallet	6 no
20	Rope 5meter, 10meter, 15meter	4 each
21	Ladder	4 no
22	Hand Gloves	10 no
23	Safety belts	10 no
24	Fire fighting Extinguisher	4 no
25	First aid box	2 no
26	Soldering Iron	5 nos
27	Wheatstone bridge	1 no
28	Electrical wiring accessories. E.g. Switch,socket ,holders etc	5 nos each
29	Portable Drill Machine	1 no
30	Tap & die Set	1 set
31	Bench Vice	5 nos
32	Working Table	2 nos
33	Drawing Board	25 nos
34	Drawing Instrument Box	1 Box
35	Mini Drafter	1 no
36	T Square	1 no
37	Desk top Computer	1 no
38	Auto Cad Software	1 no

LIST OF MATERIALS FOR 25 STUDENTS.**FUNDAMENTALS OF ELECTRICAL ENGINEERING**

Sr. No	Details of Materials	Quantity
1	Voltmeter a.c. 0—250v	4 no
2	Voltmeter a.c. 0—500v	4 no
3	Ammeter A.C. 0—5 Amp.	4 no
4	Speedometer	1 no
5	Wattmeter 0—250W	1 no
6	Wattmeter 0—500W	1 no
7	Energy meter 5-15Amp.	1 no
8	Power Factor meter	1 no
9	Frequency meter	1 no
10	D.C. power supply 30V—1Amp.	2 no
11	Emergency light	2 no
12	Lead acid battery	2 no
13	Three phase main switch 16 amp.	2 no
14	Three phase main switch 32 amp.	2 no
15	Gum boot	10 no
16	Rain coats	10 no
17	Multi meter	4 no
18	Hacksaw with blade	6 no
19	Hand Drill machine	2 no
20	Spanner Set (Double Ended)	2 no
21	Screw Driver	20 no
22	Hammer	10 no
23	Pocker	8 no
24	Files	10 no
25	Wire stripper	10 no
26	Tester	10 no
27	Pliers	10 no
28	Electrician knife	10 no
29	Mallet	6 no
30	Tennon saw	6 no
31	Firmer chisel	10 no
32	Ring spanner	5 sets
33	Box spanner	5 sets
34	Rope 5meter, 10meter, 15meter	4 each
35	Ladder	4 no
36	Hand Gloves	10 no
37	Safety belts	10 no
38	Fire fighting Extinguisher	4 no
39	First aid box	2 no

LIST OF MATERIALS (FOR 25 STUDENTS.)**ELECTRICAL MACHINES**

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.
